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Electrical Features of Essex Plant

PUBLIC SERVICE ELECTRIC CO. OF NEW JERSEY INSTALLS MUCH DUPLICATE EQUIPMENT AND CONTROL AND SIGNALING SYSTEMS TO INSURE CONTINUITY OF SERVICE AND ECONOMICAL OPERATION

HAVING THOROUGHLY COVERED the general mechanical equipment of the Essex power station of the Public Service Electric Co., of New Jersey, in the 2 previous issues of this paper, a detailed description of the electrical generating, control and station-distribution equipment may prove of interest.

At present the installed generating equipment consists of 2 Curtis horizontal type turbo-generators, each having a continuous rating of 25,000 kv. a. and delivering current at 13,200 v., 3-phase, 60-cycles when operating at a speed of 1800 r.p.m. Each is equipped with a 100-kw., 250-v. direct-connected exciter, an unusual arrangement with generators of such great capacity and high speed.

Air required for cooling the generator windings is taken from between the turbine room and the switch house, passed through air washers located in the basement of the former, and after being carried through the windings is discharged into ducts leading to the basement of the boiler house where it is delivered to the

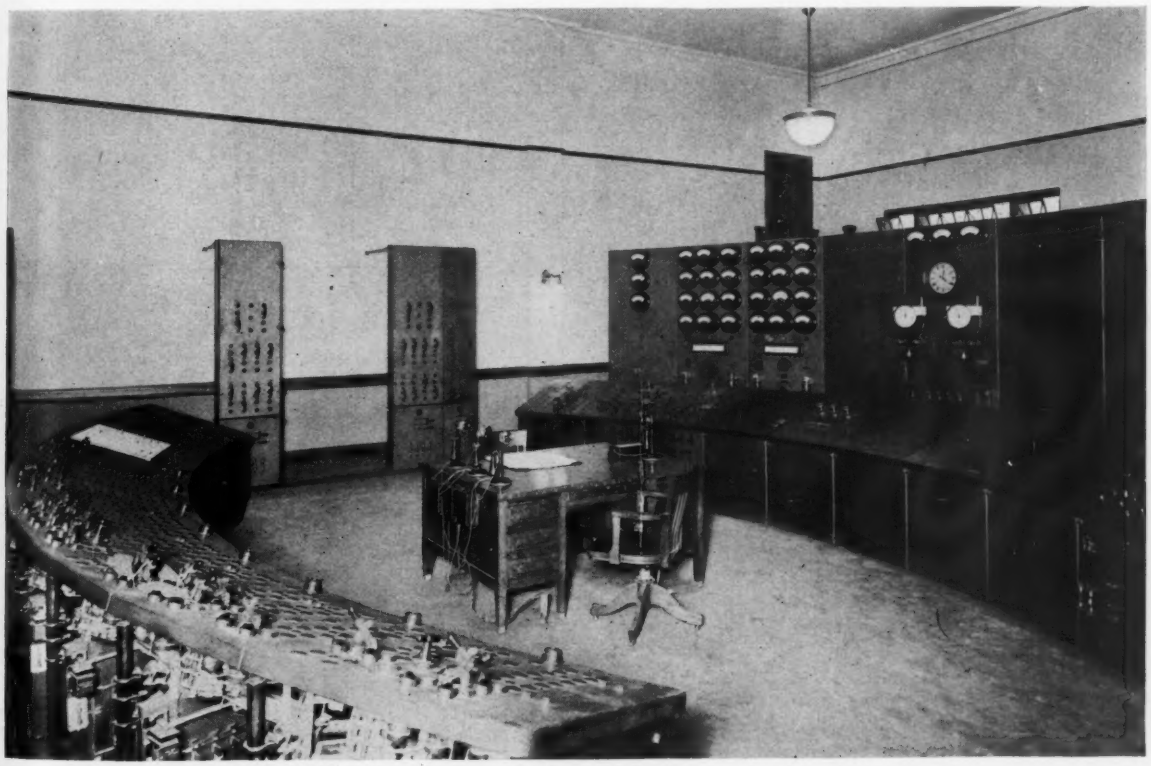

FIG. 1. MAIN CONTROL BOARD, ESSEX PLANT

forced draft blowers. Circulation of this air through the washer, windings and iron laminations is created by vanes on the revolving fields of the generators.

In the air washers, built by the Spray Engineering Co., fine sprays of water are directed into the incoming air from several directions and practically all dust and dirt caught; the air is then caused to pass over eliminator plates whereby the entrained moisture is removed. During this washing process some evaporation naturally occurs and as a result, the air in addition to being cleaned is also humidified and cooled about 15 deg. F. This treatment it is noted not only prevents dirt and dust from entering the windings and ventilating slots, but reduces the temperature of the machine windings when operating at rated capacity or, in other words, increases the capacity of the generator for a given temperature rise.

Each generator has 12 electric thermometer coils in its armature, so that the actual temperature of the various parts of the machine may be read and recorded by meters in the control room and warning thus given of any dangerous overheating.

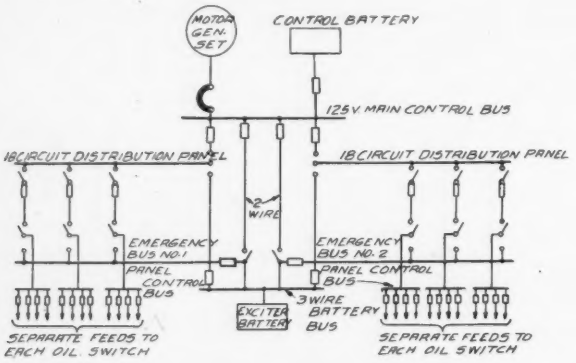

FIG. 2. ONE-LINE DIAGRAM SHOWING SCHEME OF CONNECTIONS OF CONTROL SYSTEM

As an instance of the length of time required to obtain equipment of such size as these machines, it is interesting to note that specifications were sent out January, 1914, and the contract signed June, 1914; the first unit was assembled and ready for operation September 15, 1915.

Generator and Bus Connections

The ultimate generating equipment is to consist of 6 machines, the 4 additional units to be of an equal or greater capacity than that of those now installed.

By means of the "selective" bus scheme shown diagrammatically in Fig. 6, either generator may be connected direct to any group of feeders and for the ultimate 6 generators there are to be 6 "generator buses," each machine feeding its own bus through a main oil switch. There will be eventually 6 "group switches" to each of which 11 out-going high-tension feeders will be connected through feeder selector oil switches, feeder oil switches and feeder reactance coils. By means of the generator selector oil switches, of which there will be eventually 6 per generator, any generator bus can be connected directly to any one or more of 6 group buses,

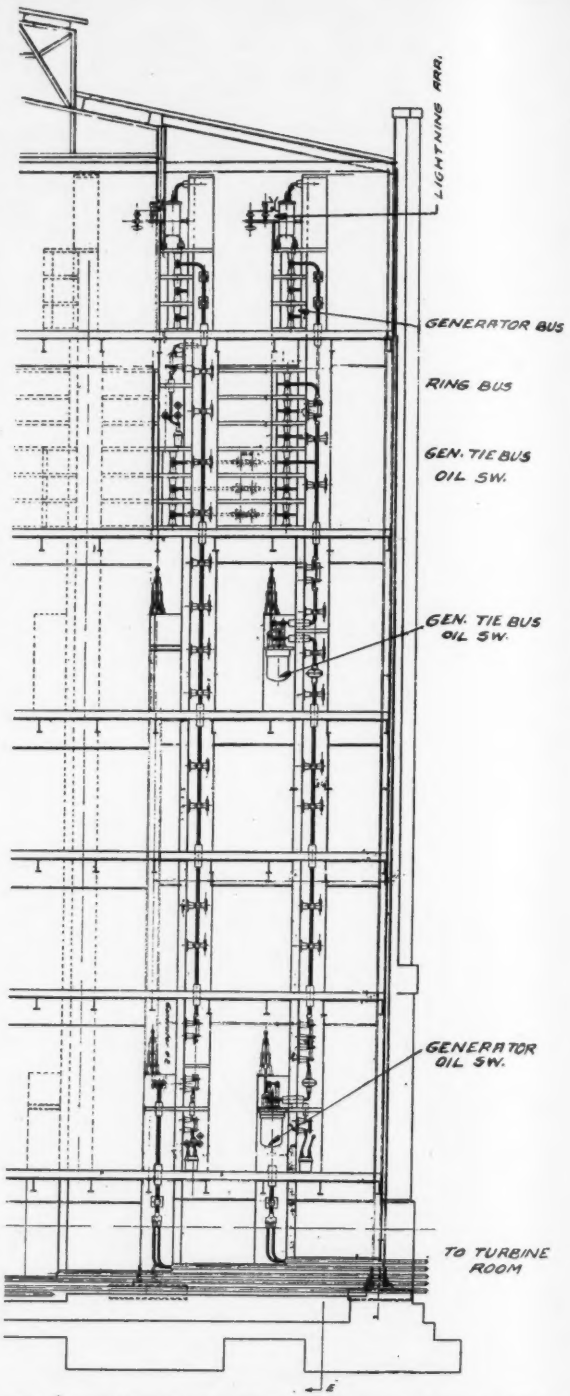

FIG. 3. TRANSVERSE SECTION OF SWITCH HOUSE WITH PRESENT INSTALLATION OF ELECTRICAL EQUIPMENT

thereby allowing any generator to feed any group of feeders, and the isolation of any feeder for special operating conditions or test. It is, therefore, evident that with the scheme of connections employed and with the existing equipment, the 22 feeders on group buses A and B may all be connected to either group bus A or group bus B as required.

In case of trouble on any individual generator bus, the machine thus affected may be connected to any other

generator bus by means of a generator tie bus through tie-bus reactance coils and tie-bus oil switches, the reactance coils protecting the windings from line surges and short-circuit currents.

Each high-tension feeder is equipped with a set of reactance coils of the semi-enclosed type, those for substation feeders being connected for 5 per cent reactance while those for tie feeders to other stations are connected for 2½ per cent reactance.

Referring to Fig. 6, it will be noted that 16 feeder oil switches and but 8 feeder selector switches have been installed on the 2 group buses A and B. As this, therefore, is but half the number of feeder selector oil switches required for the ultimate "H" connection to be employed, a temporary connection is made as indicated, so that 4 feeder switches are connected to 2 selector switches forming a 4-feeder group.

All generator main oil switches are of such capacity

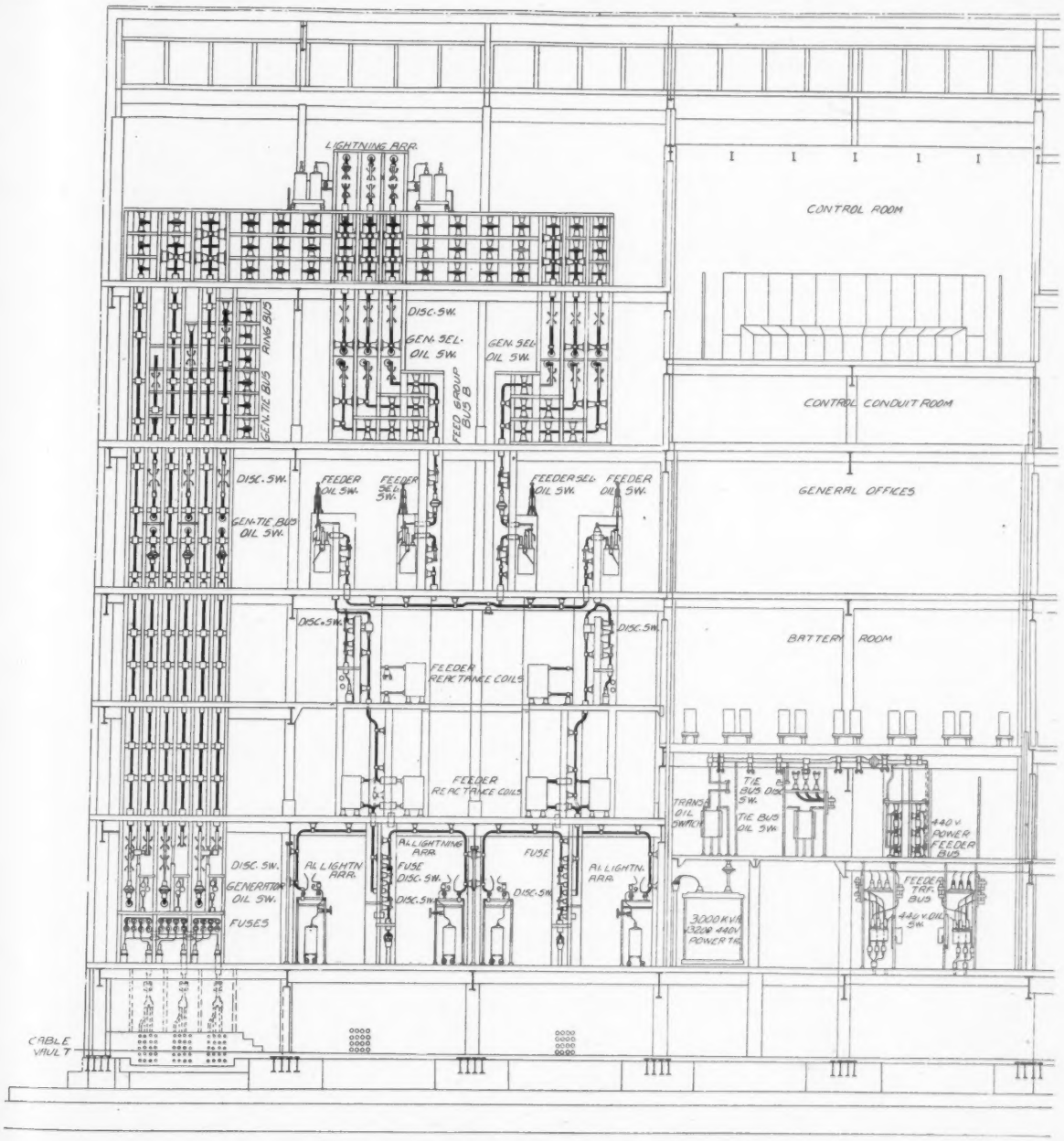

FIG. 4. LONGITUDINAL SECTION OF SWITCH HOUSE

Severe mechanical strains it is believed will be prevented from causing damage by the heavy structures provided for the buses and connections and by supporting the generator connections and all buses on large double supports as shown in Figs. 3 and 4.

as to break safely when carrying 20 times full-load current, and are protected by reverse-power relays which will operate only under full-load reversal. The tie-bus oil switches are protected by inverse-selective overload relays with a high time setting and will operate only in

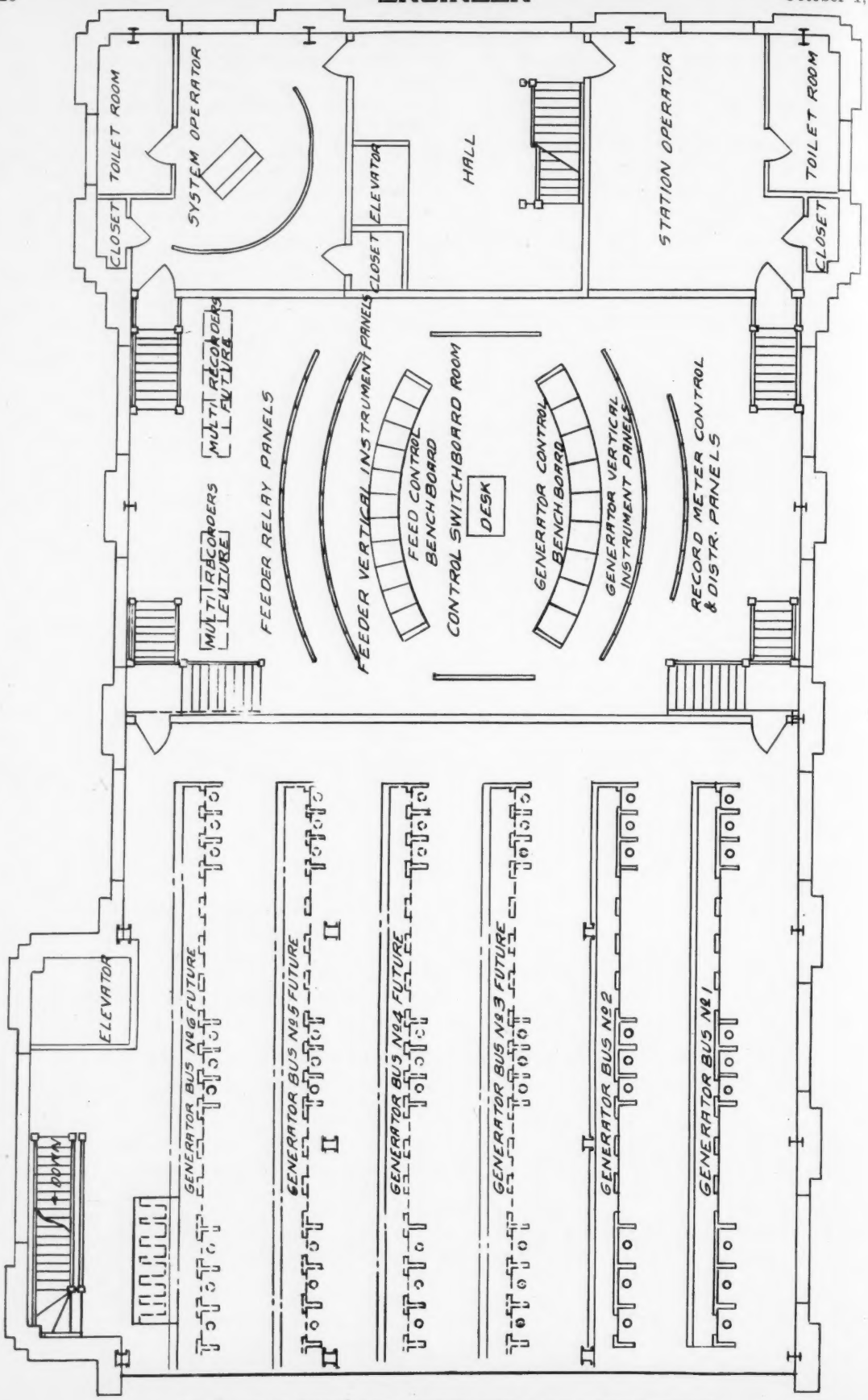

FIG. 5. PLAN SIXTH FLOOR SWITCH HOUSE AND CONTROL ROOM

case an existing short circuit is not opened by the feeder or feeder selector oil switches.

The Switch House

This structure, shown in section in Figs. 3 and 4, contains all of the switching equipment, transformers, storage batteries, control equipment, offices and elevators and is detached from the turbine house to allow of increased light and ventilation, and better arrangement of apparatus in both buildings, and lessens the chance of trouble in turbine room and boiler house reaching the switch house. A covered bridge at the north end of the switch house, third floor, connects to the main floor of the turbine room; with the completion of the switch house a second bridge will be built at the south end.

and charging of exciter storage battery, 3 motor generator sets for charging storage batteries and lighting transformers.

On the third floor are the remaining tie-bus and feeder reactance coils with current and potential transformers, storage batteries, 4 motor-operated end-cell switches with switchboard panels for emergency excitation and battery lighting, and offices.

On the fourth floor are the generator tie-bus oil switches, feeder selector oil switches, feeder oil switches, electric kitchen, dining room and offices, and on the fifth floor the 13,200-v. tie-bus, generator selector oil switches, 13,200-v. group buses, control conduit room and offices.

Generator buses with aluminum cell arresters, the main control room and the load dispatchers and station

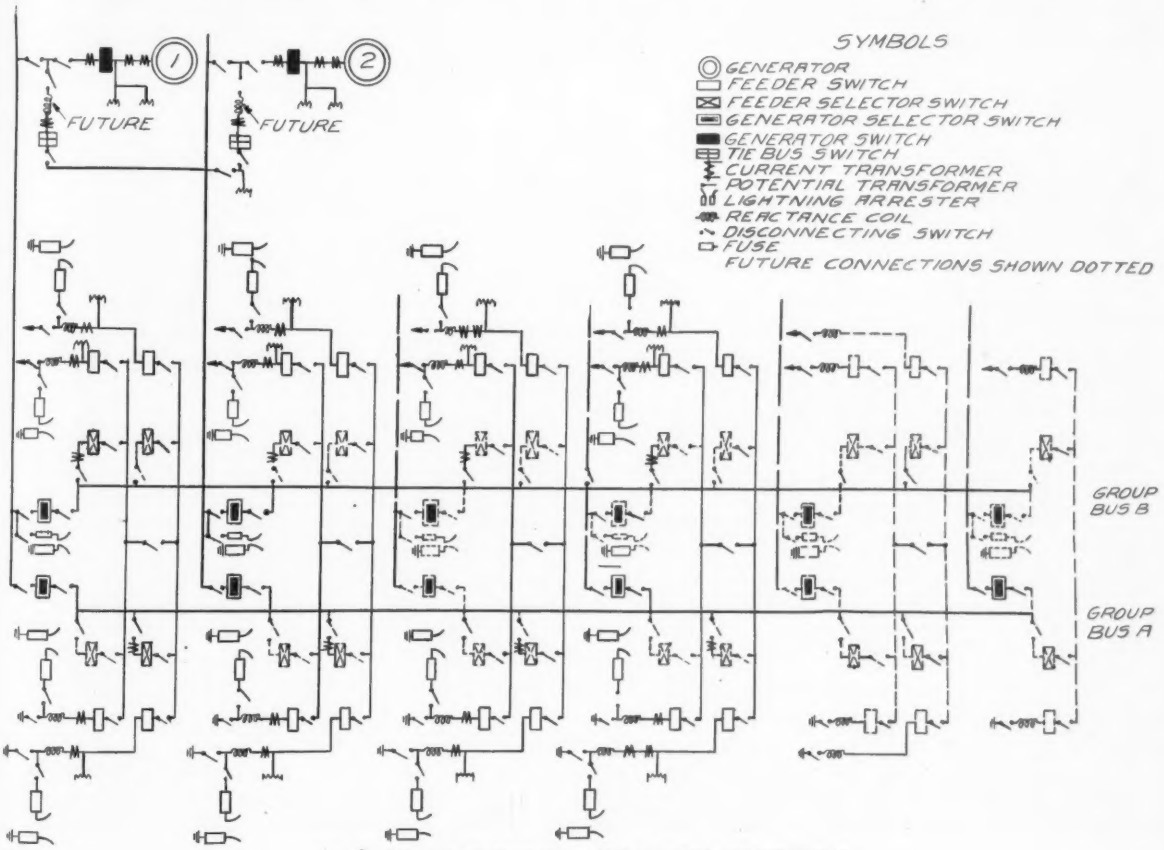

FIG. 6. ONE-LINE WIRING DIAGRAM, MAIN CONNECTIONS

Below the first floor are the vaults containing the generator, 440-v. station service and 13,200-v. outgoing feeder cables, the latter carried in underground ducts.

As shown in Figs. 3 and 4, the first floor of the switch house is devoted to the generator main oil switches with current and potential transformers, electrolytic lightning arresters on outgoing high-tension feeders, transformers, feeder oil switches and relay panels for 440-v. station power service, and the 30,000–60,000-v. cable-testing outfit.

On the second floor are the tie-bus reactance coils, feeder reactance coils, transformer secondary and tie-bus oil switches for 440-v. power station service, 440-v. buses, switchboard for station light and power service, electrician's offices are housed on the sixth or top floor.

Main leads coming from the generator terminals are carried through compartments to the turbine-room basement, where, after passing through current transformers they are continued in 3 850,000 cm. special cables per phase, run in fibre ducts, imbedded in concrete to the switch house basement. From this point insulated copper tubing is employed. After passing through the generator main oil switch on the first floor the leads branch, 3 running directly up to the generator bus on the sixth floor and 3 connecting through the tie-bus reactance coils and the tie-bus oil switch to the tie-bus on the fifth floor.

By means of the generator selector oil switches on the fifth floor, current is taken from the generator bus

to one of the group buses on the same floor. From there the current continues down through the feeder selector oil switches on the fourth floor, through the cross connections under the fourth floor, back to the feeder oil switches on the fourth floor and then down through the feeder reactance coils on the third and second floors to cable potheads on the first floor.

An aluminum cell arrester is connected to each feeder on the first floor, and provision is made for connecting a potential relay to each feeder to indicate whether it is alive or dead.

Control-Room Equipment

As illustrated in the plan, Fig. 5, and the view shown in Fig. 1, the control room located on the sixth floor of the switch house contains switchboard panels making up most of the main board from which the larger portion of the electrical equipment is controlled. Complete signaling and communicating systems are provided to keep the operators of the board in close and constant touch with the load dispatcher, turbine room and boiler house.

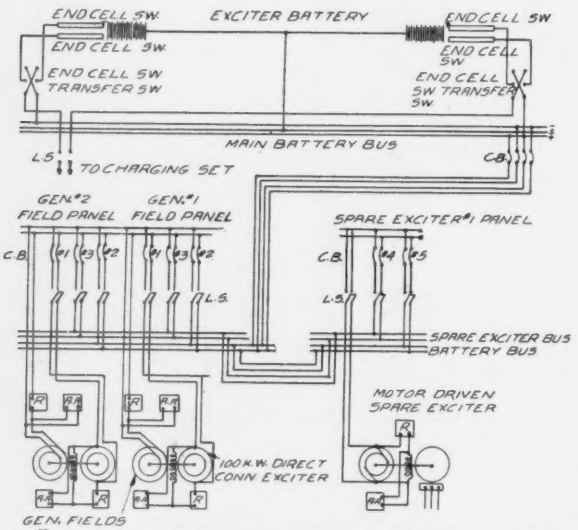

FIG. 7. MAIN CONNECTIONS, PRESENT EXCITATION SYSTEM

The control switchboards are arranged about the operator's desk as shown in Fig. 5. In both the generator and the high-tension feeder board, each of which are divided into 3 curved rows of panels, the front row of panels is in the form of a desk or bench and carries control switches and indicating lamps for the various oil switches, circuit breakers, etc. The second row consists of vertical panels carrying the indicating meters. The third row of panels in the feeder board carries protective relays, while that for the generators carries curve-drawing and recording meters.

On each of the generator benchboard panels are mounted control switches and indicating lamps for control of the generator main oil switch, generator tie-bus oil switch, generator selector oil switches, field-excitation circuit breakers, control switches for operation of rheostats and turbine governor, synchronizing and potential switches for paralleling generators and turbine room signal switches.

In addition to the necessary ammeters, voltmeters, wattmeters, frequency and power-factor meters, each generator panel is equipped with a temperature indicator having a dial switch for connection to any of 12 thermometer coils in the generator windings, an emergency excitation relay, reverse-power and overload relays and illuminated return signals from the turbine room.

The recording instrument equipment for each generator consists of a watthour meter, an ammeter, a temperature indicator, voltmeters and a frequency meter, all of which are synchronized hourly by a master clock to obtain simultaneous records.

At the sides of the room are vertical panels for the control of the station power and lighting equipment and the control and multirecorder batteries. Space is also provided for future generator voltage regulator panels and for a total of 9 multi-recorders back of the high-tension feeder relay panels.

Panels controlling station power and lighting service are equipped with control switches and indicating lamps for controlling the equipment on the first and second floors of the switch house, the connections being such as to allow the transfer of the control of this equipment to corresponding panels on the second floor.

The exciter bench panel controls the 150-kw. 250-v. motor driven spare exciter located in the turbine room while the exciter battery panels control the 4 motor-operated end-cell switches, with indicators on the vertical panel, and the 75-kw. motor generator charging the exciter battery.

Although space has been provided on each of the 11 high-tension feeder bench panels for control switches and indicating lamps for 6 feeder oil switches, 6 feeder selector oil switches and 6 synchronizing switches for paralleling feeders, only that equipment required to control the present feeders is installed. On the instrument panels are 3 ammeters and indicating lamps for potential, faulty cable localizer relay and oil switch alarm for each feeder; on the relay panels are mounted the necessary protective relays for the feeder oil switches and the feeder selector oil switches.

Substation Switchboards

These are located on the first and second floors respectively toward the north end of the switch house, the one on the second floor comprising 15 panels and controlling the station power service and lighting equipment and the exciter battery charging, partly duplicating that on the corresponding panels in the control room. The board on the first floor has relay panels for the 440-v. power service feeders, and one panel for the control of the high-tension cable testing equipment.

Battery-Room Switchboard

The battery-room switchboard located on the third floor of the switch house adjacent to the storage-battery room, carries the necessary electrically-operated circuit breakers for connecting the exciter emergency battery to the excitation buses in the turbine room and to the lighting buses on the floor below in the switch house. In addition to this there are mounted in this room 4 motor-operated exciter emergency battery end-cell

switches, with 2 panels for connecting them in different combinations for charging and discharging and one panel for emergency control feed.

Turbine-Room Switchboard

For signaling to the control room in the switch house and to the turbine room basement and for the control of the motor-operated throttle valve, an engineer's signal stand is installed on the turbine-room floor near the throttle of each turbine. Between the basement and main floor are 2 rooms, one a field-panel and rheostat room and the other an exciter room, the former to contain the field panels, main field rheostats and exciter field rheostats for the first 3 generators. In addition to these are a distribution panel for the turbine room lighting feeders and a panel for the exciter emergency battery leads.

In the exciter room at the northwest corner of the turbine room are 2 panels for the spare exciter, one for the generator end and the other for the motor end. There are also here located panels for 440-v. power feeds to the turbine room crane, the air washer, circulating pump motors and other small turbine-room equipment.

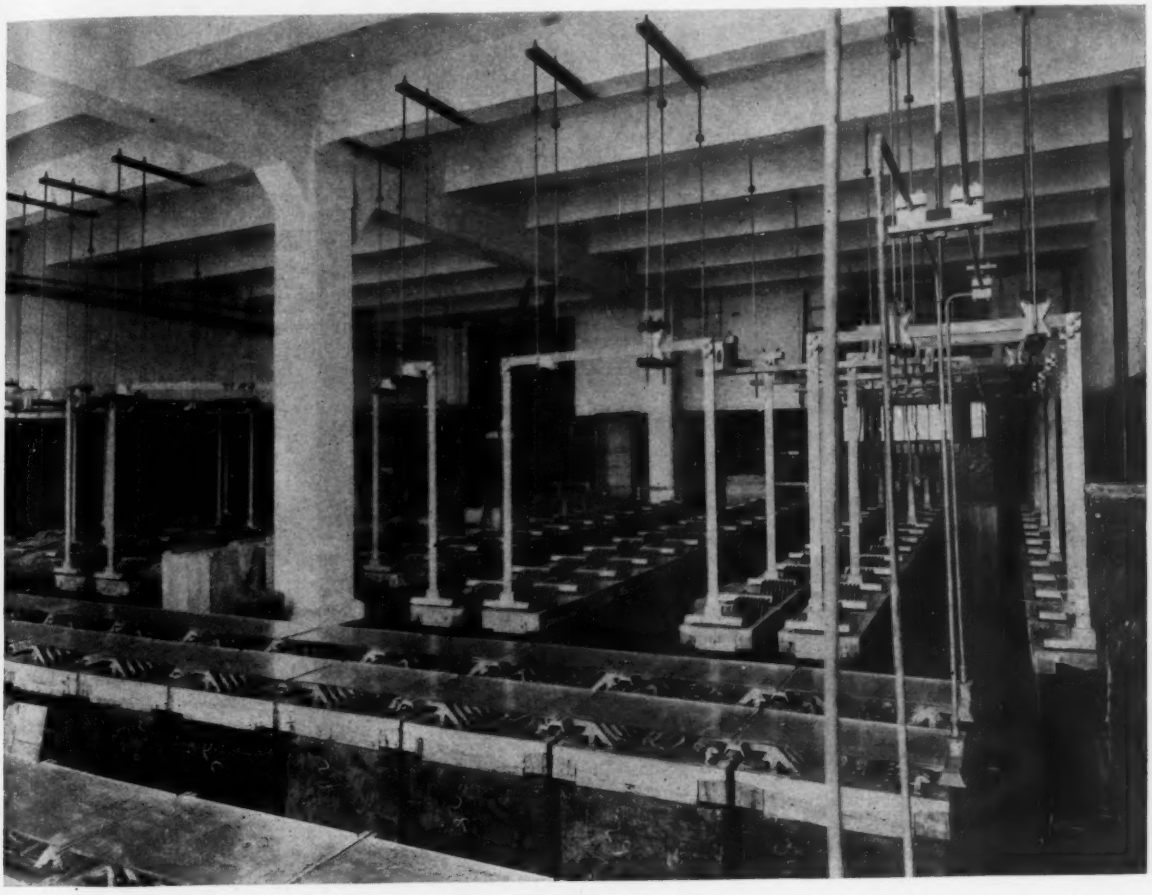

FIG. 8. BATTERY ROOM ESSEX STATION

Boiler House Switchboards

For the 440-v. power supply to the first third of the boiler house, a switchboard for the control of 4 main power feeders from the switch house, group oil switches for the 3 motor-driven boiler auxiliaries for each boiler, for miscellaneous power feeders, individual oil switches for the motor-driven air compressor and the motor-driven fire pump has been installed on the north side of the boiler house basement. Six panels carry the necessary overload relays for the electrically-operated oil switches and the watthour meters for the various power circuits. In addition there is a distribution panel for boiler-house lighting and a 125-v. oil switch control panel. Near each boiler on the main floor is a control panel for the respective group oil switches and stoker drive, forced draft and induced draft motors. The control switchboard of the other branch power feeders from the switchboard in the basement, and for controlling all motor-operated steam valves in the boiler room is located in the boiler-room engineer's office.

Another board supplied from the switch house by 3 feeders and consisting of panels with lever switches and fuses for the individual cable feeds to each motor, and other panels for watthour meters, is located on the conveyor belt floor of the coal tower. There is also a distribution panel for coal tower and outside lighting around the station.

Excitation System

In order to secure maximum reliability and independent excitation for each generator 3 sources of excitation are available. The first, or "regular," as it is called, is furnished by the shunt-wound exciters direct

connected to the generators. The second, or "emergency," is obtained from the 250-v. exciter battery located in the switch house to which the field for any generator can be connected, either automatically or manually until the third or spare excitation supply is made available. This is obtained from a 150-kw. Allis Chalmers shunt-wound motor-driven unit in the turbine room which may be started and controlled by the switchboard operator to replace the faulty direct-connected exciter.

By means of a contact-making voltmeter, provision is made for maintaining the exciter battery voltage at the required value. The battery employed for excitation purposes is of sufficient capacity to deliver 900 amp. at

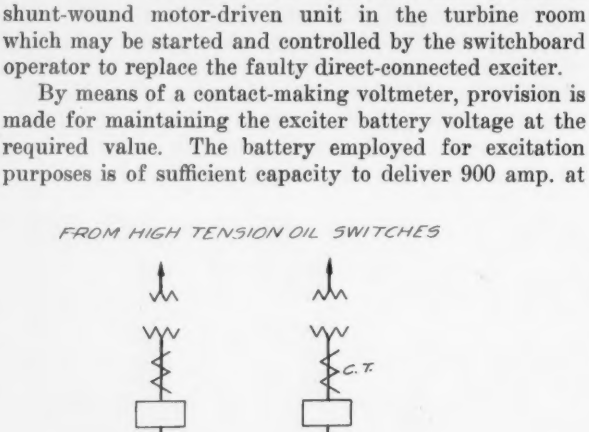

FIG. 9. ONE-LINE DIAGRAM SHOWING SCHEME OF CONNECTIONS, POWER SUBSTATION (GROUPS A AND B EXACTLY SIMILAR)

a voltage of 250 for 30 min., sufficient to excite one generator at full load over one hour or the 2 generators at full load for ½ hr.

Figure 7 shows the main connections of the excitation system.

Control System

A ONE-LINE DIAGRAM showing the scheme of connections for the control system used for the remote-control operation of most of the oil switches, rheostats, signaling, etc., is illustrated in Fig. 2. There are regular feeds from the 125-v. control battery with emergency 2-wire feeds from the exciter battery, to each of the 2 18-circuit control distribution panels in the control room. From these panels there are branch control feeds to each switchboard panel or distribution center. The control bus on each panel is separate from that on any other panel and from the panel control bus there is an individual control feed to each device controlled from that panel.

In case of failure of its regular feed from the control distribution panel, the control bus on any of the panels may be connected to either one of 2 emergency control buses provided for the purpose.

Station Power and Lighting Systems

ENERGY for the operation of the power and light units in and about this plant is obtained from the 440-v. 60-cycle power buses, the former directly from these buses while the latter is stepped down to 250 and 125 v. by means of 2 200-kv. a. single-phase transformers.

In order to maintain the intensity of the station power system and to minimize and restrict service interruptions, a complete scheme of main and relay connections is provided. As the stokers and forced draft blowers are each motor-driven a shut-down of any one or all of them, even for a short time, would seriously interfere with the operation of the boilers and undoubtedly make it necessary to drop some of the load.

Current supplied to the station power system is obtained from 2 3000-kv.a. water-cooled transformers, one being a spare unit. These transformers are in turn supplied from the 13,200-v. buses, through feeder oil switches and 5-per cent reactance coils. Provision has been made whereby, if necessary, as in the case of an emergency, power may be obtained direct from the tie feeders from the other stations.

On account of the large connected horsepower in motors the load on the power system, even with the present installation, is, as may be seen from the summary of station power load and demand shown in Fig. 11, considerable, and according to the opinion of those in charge the future load will be much greater than that now carried as commercial load by any one of the company's substations. The figures given in this summary for the ultimate station are based on 6 generating units of the same size as are now installed and the same size and kind of boiler-house and turbine-room auxiliaries.

A typical section of the power substation on the first and second floors of the switch house is shown in Fig. 4, while a one-line diagram showing the power station scheme of wiring connections is illustrated in Fig. 9. Group buses A and D are now installed, while B and C are future. Between each transformer oil switch and its group bus a connection is made through the 5000-amp. tie-bus oil switch to the tie-bus mounted near the ceiling. The group buses can be connected together only through the tie-bus by means of the tie-bus oil switches.

The transformer secondary leads and the 440-v. buses consist of 6 ¼ by 5-in. copper bars per phase, and in order to withstand the tremendous mechanical stresses resulting from short-circuits are heavily supported. The transformer lead and the tie-bus are carried on double supports and, where possible, covered, while the group buses are inclosed in a concrete structure and mounted on supports bracing them in 3 directions.

The switch house, the turbine room, the present section of the boiler house and the coal tower are each provided with individual power distribution centers. That in the former is located on the second floor and consists of 2 panels with lever switches and fuses, for the feeds to the smaller motors. The turbine room distribution center is in the exciter room under the turbine room

main floor. The feeder for the crane is connected so that with one feeder to the center, emergency service may be obtained for both the crane and the smaller turbine room motors.

For the electrical equipment in the first section of the boiler house, a distribution center is located on the north or river side of the basement, and on account of its importance and large loads carried, this distribution system has received particular attention. Three main feeders capable of carrying approximately 700 kv. a. with one in reserve are employed. Each of these feeders has an oil switch at the switch house end and another at the boiler house end, which open and close together. Power is distributed from this distribution center through electrically-operated oil switches, either to individual motor feeds or to distribution panels.

For each boiler there is an oil switch feeding its adjacent 3-circuit panel from which are fed the forced draft blower motor, induced draft blower motor and the stoker drive motor for that boiler. The oil switch and equipment for operating the motors are controlled from the individual boiler control panel on the main floor; the stoker-drive motor may be connected to run at 4 speeds and the forced draft blower motors to run at 2 speeds.

In order to protect the power transformers from the effects of a possible short circuit in either the primary or secondary connections, each of these has been equipped with instantaneous differential relays to open both the 13,200-v. primary and the 440-v. secondary oil switches. Each 13,200-v. primary oil switch is equipped with an overload relay with a high-time setting to clear any trouble which may not be cleared by the various 440-v. oil switches.

The 440-v. tie-bus oil switches are equipped with inverse time overload relays connected to current transformers located in the transformer secondary lead between the tie-bus connection and the group bus. All 440-v. feeders are protected by inverse time overload relays so adjusted that in case of a severe short circuit the tie-bus oil switches for that particular group bus will open first and thereby isolate that group bus.

Initial overload and low-voltage protection at the motors is obtained by the usual starting compensators, oil switches or contactors.

Watthour meters and ammeters provided throughout the station on the various turbine room, boiler house and coal tower motor-driven auxiliaries' panels, enable the operating department to check their operation. On account of the large number of meters required and the balanced loads on the motors, single-phase watthour meters with "Y boxes" are used.

Ordinarily lighting is supplied from a 250-125 v. 3-wire system, but if desired energy obtained from the exciter storage battery may be employed. If, however, direct current is used for any length of time it will be necessary to run a spare exciter in order to avoid rapidly exhausting the exciter battery and making it unavailable for emergency excitation.

The lighting system is divided into 2 parts, namely "regular" and "emergency," the former making up about 4/5 of the total throughout the station, and while both are supplied from the lighting buses on the second floor of the switch house, the regular system is fed from mains run in duplicate to each lighting distribution panel. From each lighting distribution panel branch feeders are run to each panel board and from there the lighting circuits. In the emergency system which carries the remaining 1/5 of the lighting, energy is taken from the lighting buses through contactor panels on the second floor of the switch house. From the emergency lighting buses supplied through these sets of contactors, the feeders run directly to the various emergency panel boards throughout the station which are separate from those used for regular lighting.

The operation of the emergency system is as follows: As long as proper voltage is maintained on the main lighting buses one set of contractors is closed and the emergency lighting system connected to the main lighting buses. When, however, the voltage drops below its normal value this set of contactors opens and another set instantly closes connecting all the emergency lighting system to the exciter battery. Then as soon as the voltage on the main lighting buses again rises, the second set of contactors opens and the first set closes.

FIG. 10. SWITCH CELLS IN COURSE OF CONSTRUCTION

In the control room and offices indirect lighting fixtures are employed, provision being made to connect part of the lights to the control battery in case of serious trouble to the regular lighting system. The turbine room has 500-watt Tungsten ornamental bracket fixtures attached to the pilasters and 800-watt units suspended from the roof trusses. The boiler room is lighted by large Tungsten units, while the main entrance to the switch house on the north side is provided with ornamental lighting columns.

STRUCTURES, CONDUIT, CABLE AND WIRING

IN THE CONSTRUCTION of the various compartments, switch cells and bus structures a special concrete brick was employed. As may be seen by referring to Fig. 10, these bricks are of the regulation size and shape but hollow with a rib through the center so that in breaking joints the openings of the various bricks will be in line with one another. Concrete is then poured into these openings and as a result a solid wall is obtained.

For mounting the various supports for the main leads and disconnecting switches cast-iron inserts built in these structures and cast into the floor are employed.

In the present parts of this station there is said to be approximately 250,000 ft. of conduit of all sizes,

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most of it being iron, although some brass and fibre conduit was employed for special runs. While a large part of the lighting and control conduit in the boiler house is exposed, that in the rest of the station is carried largely in the floors and behind curtain walls.

For generator and feeder selector leads cambric insulated and braided copper tubing is used. The feeder connections are 350,000 cm. cambric insulated braided cable, and the 13,200-v. buses are bare flat copper.

Connections in the copper tubing are made by "shrink fit" copper connectors to insure reliable electric and mechanical connections.

Cables for the 440-v. power service and the main lighting feeders are cambric insulated, lead sheathed.

Oil and Disconnecting Switches

All automatic electrically-operated oil switches are equipped with special "trip free" relays which will not allow the oil switch to be held closed on short circuit.

The 13,200-v. oil switches are mounted in concrete brick cells with the operating solenoids above and the 440-v. oil switches are mounted on pipe framework with the solenoids at the front of the switch.

SUMMARY OF STATION POWER LOAD AND DEMAND

Location	Present		Ultimate	
	Connected Horsepower	Est. Max'm Demand Hp.	Connected Horsepower	Est. Max'm Demand Hp.
Switch house.....	1,244	460	1,540	750
Turbine room.....	935	610	3,700	2,100
Boiler house.....	1,268	715	7,000	4,350
Coal Tower.....	808	595	1,560	1,060
Future coal storage and reclaiming.....	.....	...	1,200	600
Totals	4,245	2,380	15,000	8,860

All 13,200-v. disconnecting switches are equipped with positive locks whereby it is impossible to open the switch except with a switch hook.

Signaling and Communication

An annunciator for each particular class of electrical equipment and a common bell notify the operators of oil switch openings, grounds and other operating troubles which may occur.

The signaling system includes a switch on each generator panel in the control room controlling signals on a large illuminated sign in the turbine room and duplicate signals on the individual turbine signal stands. On each turbine signal stand is a switch for return signals to the control room and for signaling the pump man in the turbine room basement. The operator in the control room can also indicate on a load bulletin board in the boiler house the load being carried.

A 24-station intercommunicating telephone system connects the various offices, control room, load dispatcher's office, etc. In addition to this are several Bell telephone stations controlled from an exchange desk in the chief clerk's office during the day and from the load dispatcher's office at other times.

All station clocks and electrical curve-drawing instruments are synchronized and controlled by a master clock installed in the electrician's office. This master clock is in turn synchronized by Western Union time service.

High-Tension Testing Equipment

This equipment located on the first floor of the switch house is provided principally for the testing of outgoing high-tension cables. It is single-phase, supplied from the 440-v. 60-cycle power system and made up of a 2500-kv.a. reactance with 75, 50 and 25 per cent taps which will closely balance the capacity of any high-tension cable up to 350,000 cm. in size and 15 miles in length, at 30,000 v. Additional capacity is supplied by a 350-kv.a. testing transformer, the voltage on the primary of which is varied in small steps by a 480-point motor-operated drum controller fed from the different high-voltage taps on a 440–2000-v. regulating transformer.

Provision has been made to use the 75-kw. 450-v. exciter battery-charging set for supplying current to reduce the resistance of high-tension cables in order to locate faults more readily.

Arcing Ground Suppressor

Provision has been made for an arcing ground suppressor to be connected to the 13,200-v. tie-bus. This device automatically grounds any phase which may have become grounded by an insulator flash-over or cable failure and thus shunts the current to ground and prevents the fault from developing into a short circuit before the load can be transferred to another feeder. From experience at the Marion, Perth Amboy and Burlington power stations of the Public Service Electric Co., it has been found that these suppressors have not only been instrumental in maintaining the service, but in a number of cases have also saved the lives of men who had accidentally come into direct contact with a 13,200-v. bare conductor.

Faulty cable localizer relays mounted on the feeder instrument panels in the control room indicate which cable is grounded.

It has recently been announced that the Navy Department intends to re-engine ships in the service that are now equipped with direct-connected turbines. The first 2 to be so reconstructed will be the destroyers, Henley and Mayrant. These are to be equipped with geared turbine units, for which contracts have been placed with the Westinghouse Machine Co.

Geared turbines have been decided upon, due to the fact that they are lighter and take up less space than direct-connected units, are much better mechanically because of their small size, and materially reduce steam consumption at all speeds and especially at cruising speeds. This reduces the fuel consumption and increases the steaming radius, which is an important feature.

A new report of the Bureau of Foreign and Domestic Commerce, Washington, D. C., entitled Tariff System of South American Countries, Tariff Series No. 34, is now on sale at 25 cents a copy by the Superintendent of Documents, Washington, and gives full information regarding the tariffs and customs methods in each of the South American countries. It explains, also, the causes for the variations in practice, and shows up the unfortunate part of the provisions in some countries, as well as explaining the way in which customs regulations are tending to become simpler.

Soot Blowers

ADVANTAGES AND OPERATING METHODS OF MECHANICAL SOOT BLOWERS

EVERY grade of fuel possesses a certain calorific or heat value. How to transform the greatest possible amount of this heat value into useful power is one of the fundamental problems that demands the attention of power plant engineers.

Soot stands foremost among the nonconductors of heat. By reference to Table I, taken from Kent's Mechanical Engineers' Pocket Book, it is shown that soot has a robust insulating value about 5 times that of asbestos, hence it is one of the greatest obstacles to the proper transmission of heat.

FIG. 1. DEPOSIT TAKEN FROM FIRST PASS OF B. & W. BOILER USING BUCKWHEAT COAL

Under ordinary circumstances soot cannot be prevented, as it is formed in the process of combustion by contact of the gas with the heating surfaces of the boiler before combustion is completed, the uncombined

TABLE I. WATER HEATED THROUGH VARIOUS SUBSTANCES

Thickness of each substance..... 1 in.
Temperature applied to each.....310 deg. F.
Temperature increase of water in each case. 10 deg. F.

SUBSTANCE	NO. OF POUNDS OF WATER HEATED PER HR. PER SQ. FT.
1. Loose wool	8.1
2. Loose lamp black (soot)	9.8
3. Hair felt	10.3
4. Carded cotton wool	10.4
5. Air alone	48.0
6. Fine asbestos	49.0

carbon adhering to the heating surfaces as soot. It does not collect on all parts of the tubes or flues in the same proportion. Some portions may be fairly clean, while others are thickly coated. If the tube surfaces are kept smooth, the particles of soot precipitated will be carried through to the stack without finding a lodging place. Speed of the gases through the setting is another factor, as a high velocity will tend to carry the soot along to the stack. Bituminous coal, which is high in volatile matter, will, as a rule, cause a greater accumulation of soot upon the heating surface, than will anthracite. Excessive accumulation of soot is good evidence that the combustion process of the fuel is not what it should be, and the furnace conditions should be carefully examined.

From determinations made of the heat loss due to soot, the accompanying table* is given:

TABLE II. LOSS IN HEAT CONDUCTIVITY OF BOILER PLATE DUE TO SOOT DEPOSITS

THICKNESS OF SOOT	PER CENT LOSS
Clean pipe	0.0
1/32 in.	9.5
1/16 in.	26.2
1/8 in.	45.2
3/16 in.	69.0

Although it is common practice to base discussions on soot cleaning on the assumption that "soot," as found in steam boilers, is a black substance resembling lamp black, this assumption is not entirely true. With cer-

FIG. 2. DEPOSIT TAKEN FROM A BOILER BURNING BITUMINOUS COAL

tain kinds of fuel, the amount of lamp black or true soot varies, and the "soot" may consist largely of ash, as it often does in boilers using anthracite coal. A specimen of "soot" taken from the first pass of a B. & W. boiler using buckwheat coal of 16 per cent ash content is shown in Fig. 1. This substance has the appearance of scale, and is made up largely of a soft white ash. Figure 2 shows a specimen taken from a boiler burning bituminous coal. This "soot" is nearly black and consists of a combination of ash and true soot. While excellent combustion is usually obtained in oil burning furnaces, a small amount of soot is formed, nevertheless, and this is almost pure lamp black.

*Jacques Abady, in a lecture before the Nottingham Guild of Mechanical and Electrical Engineers.

In view of this fact, soot, as found in steam boilers, may be understood to mean pure lamp black in combination with a quantity of fine ash. Where the soot contains a percentage of ash, it may represent even a greater menace to high boiler efficiency than a deposit of pure soot. Ash has a high heat insulating quality, and as the temperature of the gases becomes higher, due to the insulation of the heat absorbing surfaces, the ash fuses into a clinker. In a water-tube boiler, as the clinker builds up, an arch is formed from one tube to another, and eventually the entire gas passage may be bridged, so that not only is the heat absorption of the boiler greatly diminished, but a damaging interference to the draft is also formed.

To determine the extent of the losses due to soot deposits, the Engineering Department of the University of Illinois conducted a series of tests with the following results:

	1ST SERIES	2ND SERIES	3RD SERIES
Equivalent evaporation from and at 212 deg. F. per lb. of dry coal	6.20	7.04	6.23
Dry coal per sq. ft. of grate surface per hour	13.40	9.09	13.40
Temperature of escaping gases	627.00	546.00	698.00

Increase in evaporation due to clean surfaces	13.0 %
Decrease in coal burned per sq. ft. of grate per hour due to clean surfaces	32.16%
Lowering of stack temperature, due to clean surfaces	17.59%

Admitting that boiler efficiency depends upon the proportion of heat that the water absorbs, to obtain a proper degree of efficiency, it is necessary to keep the heating surfaces free from soot by using some form of soot blower, the frequency of its use depending upon the rapidity with which the soot accumulates. Soot blowers are designed to discharge through a nozzle a jet of steam or air in such a manner that it will dislodge the soot particles. Compressed air is effective in soot blowing, but due to its chilling effect and resultant

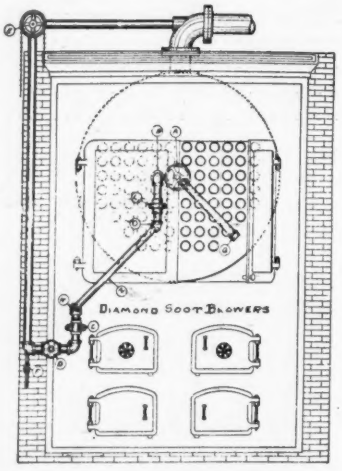


FIG. 3. DIAMOND SOOT BLOWER INSTALLED AT FRONT END OF RETURN TUBULAR BOILER

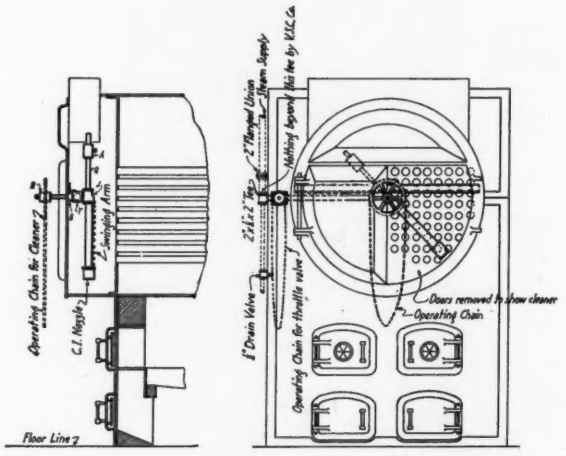


FIG. 4. VULCAN FRONT END SOOT CLEANER

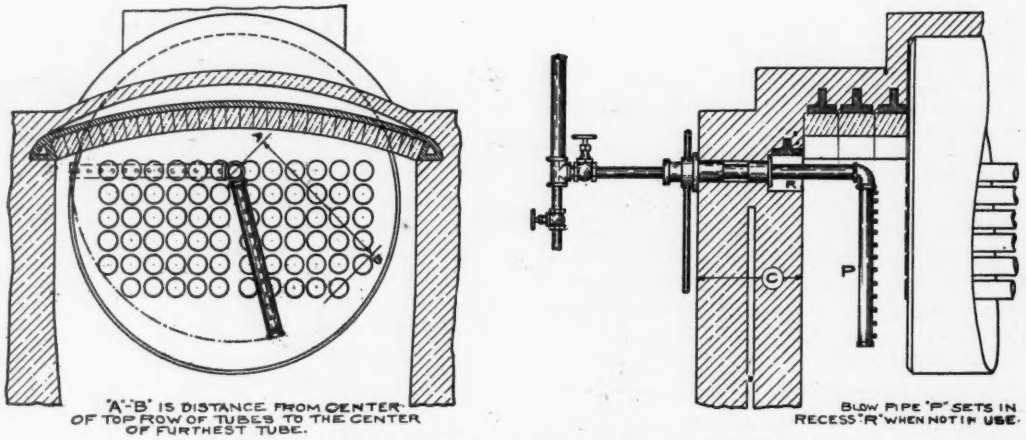


FIG. 5. INSTALLATION OF VULCAN SOOT CLEANER AT REAR END

EFFECT OF SOOT DEPOSITS ON THE EVAPORATION OF A HORIZONTAL TUBULAR BOILER

THREE series of tests were made, each covering a period of 5 days, as follows:

First Series—Soot is allowed to remain on tubes.

Second Series—Tubes cleaned each morning.

Third Series—Soot allowed to remain on tubes.

unequal strains placed upon the heating surfaces, it is not so widely employed as steam, which is usually available and convenient.

In many instances, soot blowers operated by hand are still used, the blower consisting of a steam tube of

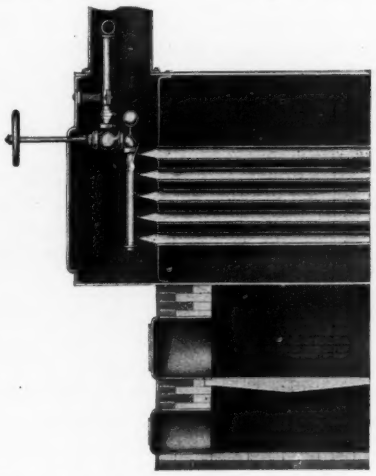


FIG. 6. SIDE VIEW OF BAYER SOOT BLOWER INSTALLATION

proper size to enter the setting or boiler flues, with some form of steam nozzle at one end and attached, at the other end, to a flexible steam hose. To use the hand blower, it is necessary to open the doors to insert the tube, and in some cases the loss due to cold air entering the gas passages is considerable, and steam pressure and draft are affected.

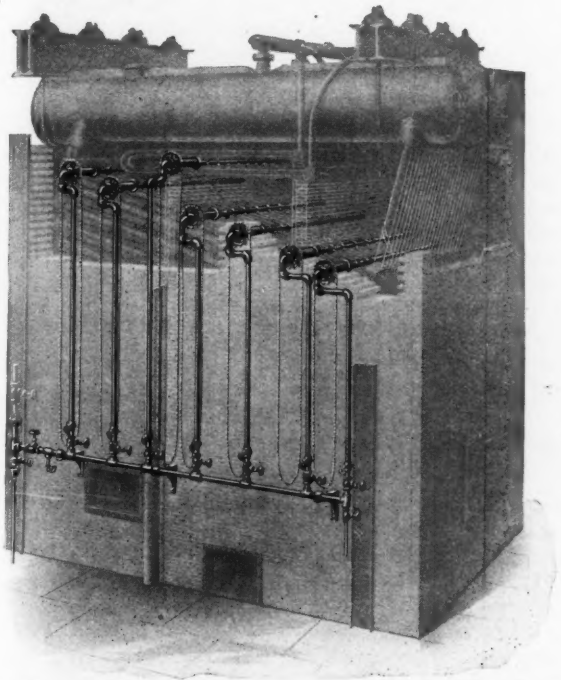


FIG. 8. B. & W. BOILER AND SUPERHEATER EQUIPPED WITH VULCAN SOOT CLEANER

Blowing soot by hand is laborious and disagreeable and because it takes considerable time, the blowing, in most cases, is not made so frequently as it should be. The time required with a hand-operated steam lance is about 3 times that necessary with a mechanical blower, and the results are about ⅓ as good.

From a series of comparative tests, it was found that the amount of steam required for one operation of the mechanical blower was about the same as that required for cleaning by hand blowers, but the boiler equipped with mechanical blower was absorbing much more heat than any of the boilers on the line that were hand blown. That is, the amount of steam used with

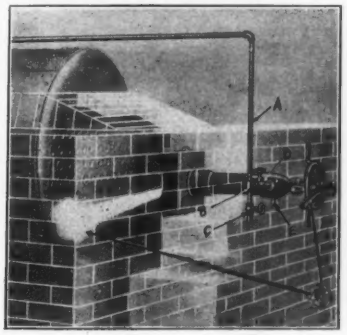


FIG. 7. MARION FLUE BLOWER

the mechanical blower in 6 min. was about the same as that used with the hand blower in 25 min., but the mechanically cleaned boiler showed a saving of 5 per cent over the hand-blown boiler, because the heating surfaces were more thoroughly cleaned in a shorter period of time.

Mechanical soot blowers are designed with various systems adaptable to any type of boiler, having nozzles so located that steam or air jets will strike all parts of

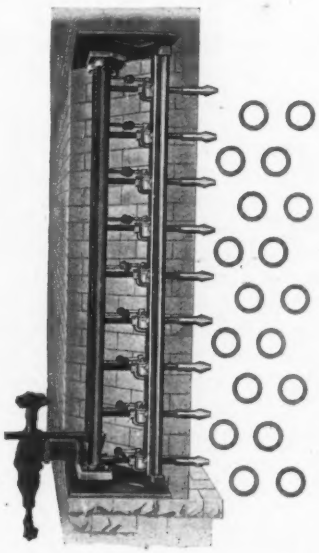


FIG. 9. VIEW SHOWING ARRANGEMENT OF NOZZLES ON BAYER SOOT BLOWER

the heating surfaces where soot is likely to accumulate. In most systems, steam is employed, and the operation of the blower consists in opening up a drip to clear the supply line of water, then opening a steam valve, and in some cases, turning a hand wheel or lever which causes

the jets of steam to travel past the ends of the flues or over different sections of the water tubes, drums, and superheaters.

Types for Return Tubular Boilers

For return tubular boilers, the Diamond front end soot blower, shown in Fig. 3, consists of a balanced blower arm located at the front end of the boiler, and parallel to the tube sheet. Nozzles are provided along one side of this arm, and it revolves about a central axis in such a manner that steam is blown into each tube. It is connected to the steam line through a swivel coupling so that the doors may be opened when necessary. The blower unit is attached to one door, and when this is opened, the mechanism swings out with it, leaving the boiler end free for inspection.

Another model of Diamond soot blower is designed to operate at the rear end of a return tubular boiler. Revolving a nozzle in various positions, directs a jet of steam into the tube ends. When not in use, the nozzle is withdrawn into a recess in the wall to protect it from the heat of the flue gases.

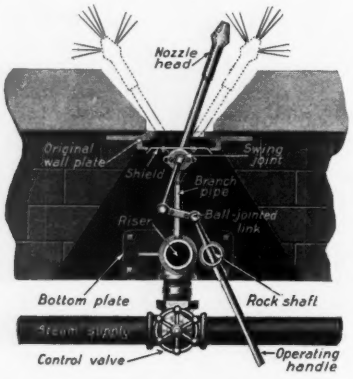


FIG. 10. DETAIL SECTION OF CLEANER POCKET WITH BAYER SOOT BLOWER

An installation of a front end Vulcan soot cleaner for return tubular boilers is shown in Fig. 4. A swinging arm is rotated by pulling a chain, and jets of steam are directed horizontally into the flues. By means of a movable element which swings in a half circle, the Vulcan soot cleaner, designed for a rear end installation, discharges jets of steam into every tube, blowing with the draft. This cleaner is operated by pushing it out from its recess in the wall, where it lies protected from the gas current when not in operation, and rotating it by means of a handle from outside the setting, and so moving the nozzle arm a few inches at a time, allowing a few seconds at each stop. An installation of this rear end blower is shown in Fig. 5.

Cleaning the flues with a Bayer front end soot blower is accomplished by rotating a blower arm which is provided with a number of nozzles. As shown in Fig. 6, the steam jets are so arranged that only 4 or 5 flues are blown at one time, and the action of the blower tends to reverse the draft in this small number of flues. As the soot from these flues reaches the combustion chamber, it is met by the volume of natural draft and carried out through the tubes not being blown.

To operate the Marion flue blower, shown in Fig. 7, valve C is opened and all condensation is blown out. After closing this valve and the pet cock, E, valve D is opened and the handwheel slowly revolved. The blower is provided with a nozzle having 3 or 4 openings, according to the size of the boiler, and by means of a valve mechanism steam is alternately turned from one opening to another. Each opening has a different angular position, and the steam jet is directed on ⅓ or ¼ of the flues at a time. Steam is diverted from one opening to another by raising the spring connected to the valve stem and moving it to the next notch on the handwheel. Set even with the inside brick wall is a large cup-shaped casting which protects the nozzle from the heat of the combustion chamber.

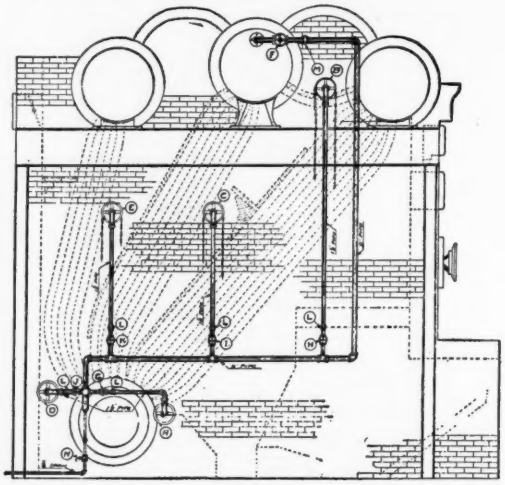


FIG. 11. DIAMOND SOOT BLOWER INSTALLED ON STIRLING BOILER

Soot Blowers for Water-Tube Boilers

Tests made upon a 250-hp. Babcock & Wilcox water-tube boiler at the Pennsylvania State College to determine the efficiency and evaporation of a boiler when using a mechanically operated soot blower is compared with the results obtained when the soot was removed from the tubes with a steam nozzle operated by hand, gave the following results:

TABLE III. COMPARISON OF TESTS WITH HAND AND MECHANICAL TUBE CLEANERS

	Test No. 1 with hand tube cleaner	Test No. 2 with mechanical tube cleaner	Test No. 3 with hand tube cleaner	Test No. 4 with mechanical tube cleaner
Duration of test, hours.....	8	12	24	24
Water evaporated per pound of coal as fired, pounds.....	8.06	8.72	8.13	8.38
Equivalent evaporation from and at 212 deg. per pound of coal as fired, pounds....	9.50	9.97	9.50	9.72
Equivalent evaporation from and at 212 deg. per pound of dry coal, pounds.....	9.61	10.06	9.72	9.93
Efficiency, including grates, per cent	68.3	71.5	64.8	66.7

Consisting of a number of rotating elements extending horizontally across the tubes, the Vulcan soot cleaner as applied to vertically baffled B. & W. boilers directs steam jets along the diagonal paths between tubes at an angle of about 30 deg. to the vertical. Each element is mounted on bearings and rotated by a chain and sprocket wheel outside the setting as shown in Fig. 8. Two elements are usually located in each pass; one blows

down diagonally at an angle about 30 deg. to the left, and the other about 30 deg. to the right of the vertical. A valve is provided for each element or unit, and the valves are blown in rotation, and generally in the same direction as the draft.

For vertically baffled horizontal water-tube boilers, the Bayer soot blower system is based upon the projection of oscillating steam jets into, through and laterally across the spaces between the rows of tubes in planes parallel to the pitch of the tubes. Nozzles are fitted on individually controlled units, and one unit serves each gas pass or compartment and is installed in one of the cleaning pockets originally provided along the side wall for hand cleaning. Each unit receives its steam from a supply line passing below the blowing units and having a drain at its lowest point for removal of any condensation before blowing.

A section view of the cleaning pocket of the first pass, Fig. 9, shows how the furnace wall is built up under the lower nozzles to deflect the hot gases from them.

Each blowing unit has a vertical and centrally located riser connected to the steam line, and controlled by its own valve. Short branches extending inward from the riser, and equal in number to the space planes between the horizontal rows of tubes, connect the riser with swing joints, the moving members of which are connected to 3-way nozzle heads within the boiler wall.

By means of sets of links and levers and a vertical rock shaft fitted with an operating handle, the moving members of the swing joints are operated, and as the shaft is rocked from left to right limits, the entire series of nozzles in that unit are swung back and forth through wide arcs. Details of this arrangement are shown in Fig. 10. The swing joints are bolted to a metal cover shield which fits against and is clamped to the 2 strips on the wall plate, which makes the cleaning pocket air tight.

An arrangement for installing a Diamond soot blower on a Stirling boiler is shown in Fig. 11. This system employs a number of horizontal rotating blower arms, usually one in each pass or compartment, which direct the steam jets downward. The arm has a bearing on both sides of the boiler and is operated by means of a chain and sprocket wheel outside the setting.

A Serviceable Oiling System

DEVELOPMENT OF A UNIT ENGINE OILING SYSTEM FOR RE-USING OIL. BY G. H. KIMBALL

SOME years ago, upon taking charge of a new plant, the engineer found a high-speed Corliss engine equipped with the usual cups for oiling but with no means of collecting the waste oil after it had been used.

He wished to install a mechanical oiling system before the plant started to operate, but his employer could not see the need of having such an arrangement and the most that he would allow was the piping of the drain to points where the oil could be caught in pails.

The crank pit had a 2-in. opening, the eccentric pan ¾ in. and the outboard bearing 2 ⅜-in. openings.

In Fig. 1, the pipe from the crank pit is shown coming into the basement and is connected to the tee B; pipe 13 is ¾-in. and brings the oil from the outboard bearing and the eccentric pan. This was all that was done for some months, but the matter kept fresh in the mind of the engineer and he found that there was some water in the waste oil and that it was difficult to filter with water in it, so he endeavored to get a separator to remove this water.

The employer being agreeable, he had a piece of 8-in. pipe about 2 ft. long threaded at each end and capped, with holes tapped for 2-in. pipe in each cap.

The separator is shown in Fig. 1 with the pipe from the tee B running into it. This pipe extends to a point near the bottom. Around the pipe on the inside is a baffle plate to break up the particles of oil and water. C is a short piece of 2-in. pipe fitted with a plug in the bottom to serve as a sediment chamber.

The operation of the separator is as follows: When it is in service the water fills it up to the level of the horizontal section of pipe 5. Pipe 4 is slightly higher than 5 and conducts the oil to the filter. Since the oil is lighter than the water, when the water stands at the level of pipe 5, the oil will be somewhat higher so that it will flow out pipe 4. Since the water coming in at the 2-in. pipe will tend to remain at the bottom of the separator and the oil will rise through it, any heavy particles of matter will remain at the bottom so that the separator accomplishes some of the cleansing of the oil. It will also be seen that since pipe 5 takes out from the bottom of the separator, the water level could

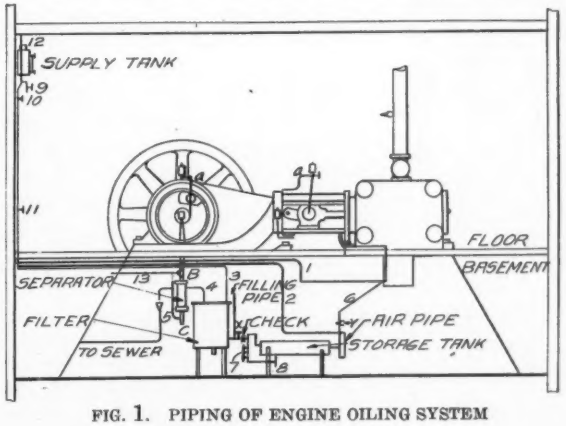


FIG. 1. PIPING OF ENGINE OILING SYSTEM

drop considerably before any oil would run out of pipe 5. The height of the horizontal must be adjusted, for if it is too low the oil will not run out of the pipe 4 at all. Pipe 5 should be vented at the top of the riser to prevent siphoning.

After the separator had been installed, a crude filter

was used to reclaim the oil and use it on the engine again and it was over a year after this time that the employer after much persuasion allowed a little more money to the engineer toward putting in a complete system.

A filter that should be capable of handling a steady stream of oil was constructed out of a steel can of 26 gal. capacity. A plate was made to fit in the top and this held a cylinder of wire netting about 8 by 24 in., which was covered with fine woven cloth. From the filter, the oil runs to the storage tank through pipe X. This tank was made from a discarded hot water tank and will hold about 40 gal.; on it there is a drain at 8 and a gage glass at 7. The oil from the filter is taken out 4 in.

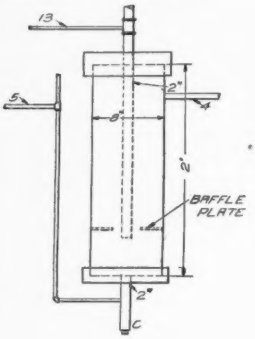


FIG. 2

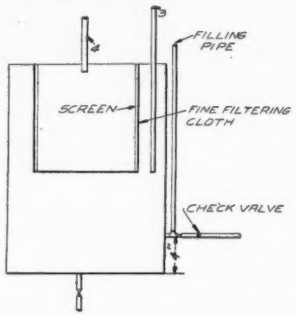


FIG. 3

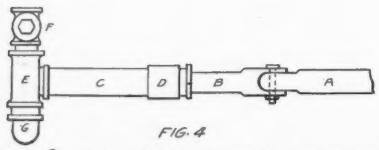


FIG. 4

FIG. 2. SECTIONAL VIEW OF SEPARATOR
FIG. 3. SECTIONAL VIEW OF OIL FILTER
FIG. 4. OIL PUMP

above the bottom so that any water or fine sediment may settle and be drawn off through the drain shown in the bottom.

From the storage tank there is a pipe, 6, which is taken from a point 1½ in. from the bottom, a check is placed at Y and the pipe then leads to the pump shown in Fig. 4 which is driven from the exhaust rocker arm on the engine. As will be seen, this is made principally of pipe and fittings and is of ¾-in. bore by 4½-in. stroke. In Fig. 4, G is the suction end connected to pipe 6, Fig. 1, F is the discharge valve and the other parts are plain.

To check valve F is connected pipe 1 shown in Fig. 1 and this runs up the wall to the supply tank and as it can pump more than is needed by the feed valves, the tank overflows through pipe 3 to the oil reservoir of the filter and thence to the storage tank again.

The supply tank was an old expansion tank and was fitted with a gage glass and valves arranged to drain it if necessary. It has a capacity of about 25 gal. From it a pipe leads to the engine and at 3 points in this pipe are taken off ¼-in. pipes to supply the feed valves as at a, a at the bearings.

At first there was no pump attached and the engineer raised the oil from the storage tank by means of compressed air through pipe 2 in Fig. 1; to avoid an overpressure on the storage tank, he made a small relief valve so that it would blow at 25 lb. pressure. When the air flowed into the storage tank, the check valve on pipe X closed and the oil flowed through pipe 6 into the supply tank until there was sufficient quantity in it. This required a little more attention than the pump and can be used now if the pump should get out of order.

While there were some problems that needed to be worked out at first before the operation was smooth, in time, everything worked satisfactorily and the engineer was well pleased.

The material that he was obliged to obtain from outside the plant amounted to about $50.

A NEW EDITION of the Steam Boiler Rules of the State of Massachusetts has been issued by the District Police of the state, in convenient pocket form. It is handily indexed for quick reference, and contains some changes from the previous editions.

It is to be regretted that it has not been possible to bring about agreement between the Massachusetts Rules and the rules formulated by the committee of the American Society of Mechanical Engineers, since the adoption of a uniform code for all states is greatly to be desired; but the judgment of those in authority in Massachusetts must, of course, be respected for that community, and such differences as exist are in the direction of stricter requirements by the Massachusetts Rules than have been embodied in the A. S. M. E. code. Whether the rules of the Massachusetts Board are stricter than necessary for safety, is a question on which there will naturally be difference of opinion. The present conditions will have largely the effect of preventing other than New England boiler builders from competing in Massachusetts, and this will work to the disadvantage of those buying boilers in that state and largely in the surrounding states, since the Massachusetts Rules are considered as standard throughout New England. Aside from this regret, that uniformity of codes has not been possible to secure the Massachusetts Rules are to be commended, and the issue in the new form is a great improvement over the older form, while nothing of readability or clearness has been sacrificed.

REPORTS RECEIVED by the United States Geological Survey show that the mine production of lead and zinc ores during the first 6 mo. of 1916 was much larger than that of any preceding 6 mo. The lead and zinc mines have been able to produce all the ore needed to supply the increased capacity of the smelters. The ore and concentrates were sold at prices which yielded large profits, notwithstanding increased costs of production and the working of large quantities of low-grade ore which could not be mined at a profit under normal conditions. High-grade zinc concentrates free or nearly free from lead and iron continued to be in demand, and the base price offered for such concentrates was generally much higher than that offered for low-grade concentrates.

Lubrication and Lubricating Oils*

THEORY OF LUBRICATION AND THE REQUIREMENTS AND PROPERTIES OF GOOD LUBRICANTS. BY F. W. MANN

IN A general way, lubricating oils may be defined as liquid, greasy, unctuous, slippery, neutral bodies, insoluble in water, free from volatile matter, gum and acid, and used for reducing or preventing excessive friction.

There are 2 other words which we constantly use in connection with lubricating oils and which need to be defined. I have reference to the words "adhesion" and "cohesion."

By "adhesion" we refer to the adhering, sticking properties of one body to another body, penetrating its pores and giving it a slippery, or lubricated, surface.

By "cohesion" we refer to the intermolecular clinging together of parts of the same body. For instance, a drop of water on a smooth piece of writing paper or polished iron rolls over it, at the will of the operator. It does not adhere and does not penetrate quickly into the pores of the paper or iron. It has no adhesion but much cohesion. It is not a lubricant. Place a drop of kerosene oil or light machinery oil on the same smooth piece of writing paper and it will instantly penetrate into the pores of the paper, forming a grease spot, giving the paper a slippery surface. In the same way the oil acts on the polished iron. It shows much adhesion, but little cohesion. It is a lubricant.

In a properly lubricated piece of machinery the lubricating oil forms a liquid cushion between the rubbing metallic parts; some of the oil adheres to the stationary bearings and some of it is forced along in the direction of and with the moving shafting; the moving shafting is also cushioned with the same lubricating oil. We have therefore external as well as internal friction. The friction of lubricated surfaces is subject to the internal friction of the lubricating oil—its cohesion or viscosity—and the friction of the rubbing surfaces.

If we add pressure to the lubricated surfaces, the general rule will be, the greater the pressure the larger the friction, though we also have some variations at smallest and largest pressure.

Furthermore, the friction of lubricated surfaces is subject to the temperature and changes of the rubbing surfaces while in motion. New bearings will cause more friction than older, polished ones. The friction between bodies of the same substance is larger than that of different substances. The machinist knows this and constructs one part of the rubbing surfaces of steel, the other of a softer metal, say babbit or iron.

The internal friction of lubricating oils is of great importance and corresponds to the viscosity of the "body" of the oils. For some purposes—for instance under the heavy pressure and great velocity, it is necessary to use a viscous or cohesive oil, at the same time the higher internal friction of such an oil may be objectionable and can be reduced greatly by the addition of certain percentages of an oil with small internal friction, which otherwise conforms to the stipulated specifications. Such compounded lubricating oils are for instance the heavy, viscous mineral cylinder and valve oils with admixtures of small percentages of highly-refined, neutral, non-drying vegetable and animal oils, like olive, rape, cola, neatsfoot, tallow-oil. By this compounding the viscous mineral lubricating oils still keep their body, their strength to carry heavy loads and at the same time become "sprayable," that is, they can be atomized with steam into a fine spray, causing the oil to form a thin film or coating over the parts of the machinery to be lubricated. Such compounded oils also show in the sight-feed lubricators smaller drops than the straight, non-compounded heavy mineral lubricating oils.

Internal friction of lubricating oils is increased by the presence of gums, resins, mineral-bodies, mineral-acids, alkalis, tar, soaps, water, fatty-acids, and such bodies may also seriously affect the metallic parts of journals and bearings and cause electrolysis.

A good lubricating oil must adhere tenaciously to the rubbing surfaces; it must form a liquid cushion between these surfaces; it must withstand and not become displaced by any pressure, blow or shaking motion; it must not lose by evaporation, either at ordinary temperature or at the highest temperature to which it may be exposed, while in use; furthermore, it must not become chemically changed while in use. It must combine highest possible fluidity with greatest adhesion. Good lubricating oils must keep their state of fluidity as nearly as possible the same, within reasonable changes of temperature.

Uniformity of consistence at varying temperatures is a most desirable attribute of a good lubricating oil.

Mineral lubricating oils have today almost entirely taken the place of vegetable and animal lubricating oils. From practical experience we have found and are verifying it in our laboratories, that carefully concentrated mineral lubricating oils taken out of the paraffine, olefine and naphthene series of hydrocarbons give the most satisfactory results.

The theory which explains the high quality of the mineral lubricating oils is partly based on the assumption that the molecules forming the crude petroleum are present in the shape of perfect globules or balls. It is the rolling ball which causes the least internal and external friction; it exposes the smallest surface to the load or pressure resting on it, and therefore resists its crushing, flattening effort better than any other geometric figure we have. Since understanding and adopting this globule theory, the so-called ball-bearing journals have been successfully introduced for many purposes. The globule theory underlies the manufacture of high-grade lubricating oils from crude petroleum. We are living in the age of conservation. We know we cannot improve perfection. A perfect round ball is the standard given us in the crude and we are trying to keep—to conserve its shape—and to free it from adhering impurities.

*From an address before the American Petroleum Society.

The constantly increasing and broadening fields for lubricating oils, the new fields for improved machinery —all depending on the right quality of lubricating oil to move them—keep the manufacturer of lubricating oils on the alert all the time and in close touch with the mechanical engineer and machinist. All pure hydrocarbons are colorless; therefore, chemically pure mineral lubricating oils are of water-white color. While this is a theoretical axiom, and holds good under all conditions for obtaining the highest quality and efficiency of all hydrocarbons, practically to come up to this state of purity would involve a great expense, a big loss of material, and would not be necessary in most cases. We are able to remove the impurities accompanying the mineral lubricating oils in many ways, chemically and mechanically. Strong acids (such as sulphuric) do not affect the pure paraffin and naphthene hydrocarbons at ordinary temperature, and very little the pure olefines. At the same time this acid changes, scorches, burns, removes some of the impurities. Again strong alkalis remove some of these impurities and likewise bichromates, chloride of lime, permanganates and other chemicals. Furthermore, we have many filtering substances, as for instance bone-black, animal-charcoal, Bauxite, Fuller's and infusorial earth, which have great affinity for the colored and color-giving impurities of the mineral lubricating oils, and for this reason are much used.

The manufacturer of mineral lubricating oils does not claim to improve the hydrocarbons, which are given him, ready made in a high state of natural perfection in the crude petroleum. What he claims and tries to accomplish is to separate and purify the hydrocarbons in such a way as to conserve their physical and chemical properties, and to give them to the consumer in such a state of purification as will enable him to obtain the highest possible lubricating efficiency for his purpose.

The ideal lubricants' adhesive qualities are infinite and its cohesive qualities are nil. This axiomatic definition or self-evident truth, a priori, admits only liquid lubricants—lubricating oils—and excludes all solid, erroneously called lubricants, such as mica, soapstone, talcum, plumbago or graphite from the list of true lubricants. Why? Because the simple fact of their state of being solids proves that the cohesion of their molecules far exceeds their adhesion, they are lacking the essential character of a true lubricant, viz.: the movability of its molecules, the rolling balls or globules.

The first and essential condition of a true lubricant is, therefore, its liquid state when put to work. There are many solid lubricants used with perfect satisfaction and great economy, such as greases of all descriptions, but these are all prepared in such a way and for the purpose, that when applied they melt by the friction heat produced, that is they become liquefied, or are converted into lubricating oils.

If such solid lubricants or greases contain solids, such as we have mentioned before, they are added for the purpose of filling in loose bearings, or imperfections in the finish of the metallic rubbing surfaces, or to retard the feeding and hold the melted greases—the lubricating oils—to the sliding or rolling surfaces.

A Successful Hot Water Heating System

General Scheme for Heating Office Building. By J. C. Hawkins

OF THE many types of heating systems in use today in large buildings, the direct hot water system described herein has been found to be one of the most compact, easily operated and as satisfactory as any the writer has ever seen.

This system is located in a 3-story and ground level basement building, with a high attic, built in the form of a hollow square with 2 open courts. It is of such dimensions that 70,000 sq. ft. of direct and 30,000 sq. ft. of indirect hot water radiation is required, the indirect being used for a special part of the building in connection with the ventilating system. The water is heated in a heater located in the engine room, using exhaust steam supplanted by live steam when necessary, and is forced through the mains and radiators by an 8-in. centrifugal volute pump driven by a variable speed compound wound motor. The main supply lines from the heater run to the attic through a pipe stack, at which point they are divided into 3 main branches as shown in Fig. 1. One branch from the main riser extends to the north end of the building, where it is divided into 2 branches, following the outside wall and extending across the north end and a part of the east side as far as the inner end of the court. The second branch extends through the center hall to the east range, where it is divided into 2 branches as stated before, and also branches are taken off to supply the radiators in the center hall. The other branches extend around the east and south sides as before. The third main connects into the ends of the other 2 main systems, and supplies the radiators around the court walls. The advantage of this system is that in case any part of the main lines breaks or other trouble occurs, it is only necessary to shut off a part of the system. The central portion of the west side within the dotted square is taken care of by the indirect system, which also heats the stairways. As the north and northwest sides usually require the most heat, there are more square feet of radiation than in the other end of the building. The return system is placed in tunnels below the basement floor, and is arranged in the same manner as the attic system. The entire system is covered with suitable covering and painted. In the tunnels, this covering is of granulated cork painted with asphaltum; in the other parts, with 85 per cent magnesia painted white.

Mains and branches are anchored, and the expansion and contraction taken care of by expansion loops. This is a much better method than by the use of expansion joints, which are often unsatisfactory and are apt to leak. These loops give no chance for leakage, and are always free to move. They require considerable space, but in this case are hung from the roof trusses and are out of the way. From these branch lines drop legs are taken at intervals, as a rule supplying one radiator on

each floor. The radiators are placed directly one above another in front of the windows. The lower end of the drop leg is connected to the branch return line in the tunnel.

There is a gate valve at each end of the drop leg, the one at the upper end being of the lock shield type with key handle, which is adjusted to give the proper amount of circulation through each leg; it can be changed only by someone who has a key to the valve. At the lower end a plain gate valve is used, and there is also a bleeder valve at the lower end of each leg by means of which it may be drained when repairs are necessary. About 120 of these drop legs supply 487 radiators of various sizes, most of which are 27 in. wide and 32 in. high. Each radiator has 2 union radiator valves, one on the flow and the other on the return, and also an automatic air valve. The advantage of this is that in case it is necessary to remove a radiator for repairs, or to be replaced by a larger or smaller one, it is only necessary to cut the heat off from the one room. The section of piping between the flow and return connections shunts the water through the radiator, which action is assisted by the means of special fittings. The air cock is of the key type and is used only when the radiator becomes air bound, which seldom occurs except when the system is filled after being empty.

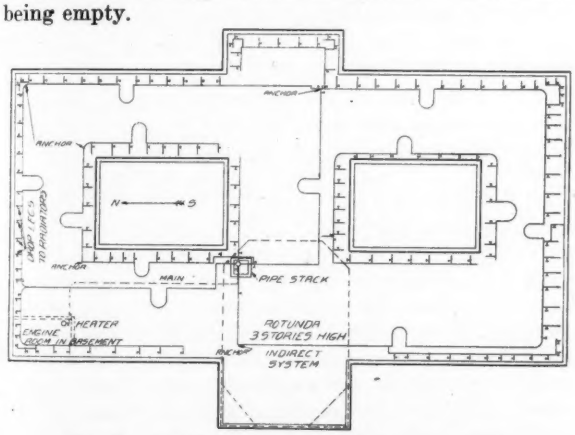


FIG. 1. PLAN OF HEATING MAINS IN ATTIC

All valves used on the radiators are of the packless type, which requires absolutely no attention after it is properly adjusted and does not leak with a change of temperature. Figure 2 shows the manner in which the bonnets of these valves are constructed. This valve has a body of the usual type, with a bonnet of larger diameter than the ordinary valve. The cap of this bonnet has a shank in the center which is threaded to fit the stem. Around the shank is placed a composition bellows, the upper end of which is flanged, and is clamped under the cap of the bonnet. The lower end of the bellows is closed, and is formed to fit the lower end of the stem to which it is clamped by the valve disc. The bellows is made of thin brass, and is caused to open and close as the stem is turned up or down.

This bellows prevents steam or water from coming in contact with the stem and escaping around it. The valve cannot leak as long as the bellows is tight, and it is easily operated. The seat is of composition, or a brass disc may be used. This valve is suitable for hot water, low-pressure steam or vacuum system. When used for hot water systems, in some cases a small hole is drilled in the seat to allow a little circulation through the radiator when it is closed.

Figure 3 shows a sectional view of one range, showing the manner in which the mains are supported, and the connections to the radiators. The drop leg is concealed in the wall with only about 2 ft. of pipe at the radiator showing. In a dome on the west side of the building is placed an expansion tank, Fig. 4, about 24 ft. above the attic mains. The makeup water supply enters this tank through a float valve which admits water from the house service system when necessary. There is also an overflow taken from this tank to the sewer to prevent flooding. This is necessary for the reason that the system contains a large volume of water,

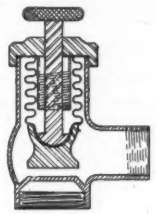


FIG. 2

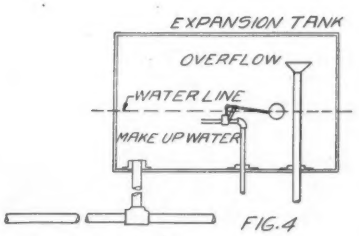


FIG. 4

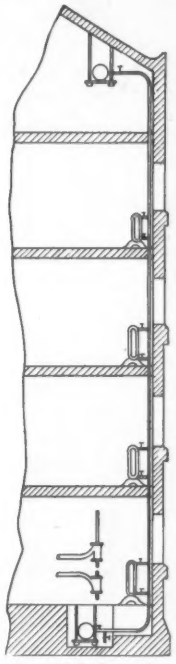


FIG. 3

FIG. 2. VALVE BONNET CONSTRUCTION

FIG. 3. ELEVATION OF PIPING SHOWING RADIATOR CONNECTIONS AND MAIN SUPPORTS

FIG. 4. EXPANSION TANK

and a few degrees difference in temperatures causes considerable difference in the volume of water in the system and must be taken care of by the tank.

There is also a 4-in. connection to the sewer from the main line at the lowest point and also a 4-in. supply line to the house service for filling and emptying the system at the end of each season. During the summer, when the system is drained, all valves are repacked except those that require no packing, and as a rule it is unnecessary to repack any of them during the heating season.

Automatic air valves are placed on the branch line in the attic to trap out any air that may get into the system, and thereby prevent circulation of water. These air valves are used mostly in filling and emptying the system.

Figure 5 shows the heater, circulation pump and condensation pump in the engine room. Exhaust steam

from the generating units is used for heating; when this is not sufficient, live steam is admitted from the main steam line. The heater consists of a vertical shell filled with small corrugated copper tubes similar to a surface condenser. The water passes through the tubes 3 times, the tubes being surrounded by steam. Exhaust steam passes through an oil separator to the heater, and the condensation is taken care of by a simplex vacuum pump, or in an emergency may be drained to the sewer. The pump discharges through a skimming tank to the feed water heater, and the condensed steam goes back into the boiler.

In cold weather, about 90 per cent of the water evaporated in the boilers is returned in the form of condensation from this, and the live steam heating systems of other buildings. No trouble is experienced with oil in the boilers.

The temperature of the entire building is controlled from the engine room. The radiation is proportioned on such basis that a water temperature of 180 deg. will be

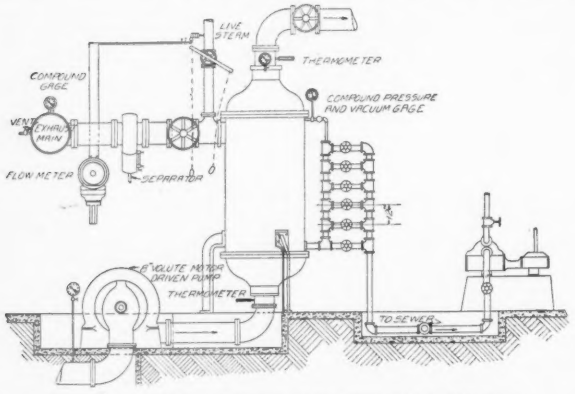


FIG. 5. HEATER, PUMPS AND PIPE CONNECTIONS

required to heat the building when the outside temperature is zero; at any other temperature, the sum of the outside temperature and that of the water in the system should equal 180. At night, when the building is not occupied, the water temperature is carried about 20 deg. lower than this scale. As a rule, the speed of the circulating pump is so regulated that there will be a difference of from 8 to 10 deg. in the temperature of the supply and return water at the heater. A thermometer is located in the main at each end of the heater, as shown in Fig. 5.

During a windy day, or when the air is damp, the circulating pump is speeded up to give less drop in temperature through the system, thus insuring water of equal temperature for all radiators.

Temperature is regulated in either of 2 ways. When exhaust steam is used alone, the quantity admitted may be controlled by a valve in the exhaust line, the balance going to atmosphere through the back pressure valve near the heater. This valve is set to open automatically at 3 lb. pressure to prevent over pressure in the exhaust lines; but, as the system is usually operated at a low vacuum of about 2 to 4 in., the back pressure valve is held open by a rope when all of the steam is not used in the heater, and at such times the back pressure is slightly above atmospheric pressure. The other means of controlling the temperature of the water is by changing the amount of surface in the heater exposed to the steam. This is done by an arrangement of valves, one 12 in. above the other, in a drip stack at the side of the heater. When it is desired to reduce the heating surface the lower, second, third, etc., valves are closed, which causes the heater to fill with condensation to the level of the lower valve remaining open, thereby reducing the surface exposed to steam. With ordinary temperature of water in the heating system, and the back pressure valve closed, a vacuum of about 12 in. may be carried in the exhaust mains. The engines, however, were not designed to run on a vacuum, and work better without it; for this reason, it is carried only high enough to prevent any back pressure above atmosphere on the engines. This is regulated by a ½-in. vent on the main exhaust line, the opening of which is regulated in accordance with a compound gage. There is also a compound gage on the suction line to the pump. A water pressure gage on the suction connection to the circulating pump, and another on the discharge from the heater, show the loss of head through the system and also through the heater, the difference in reading being corrected for difference in elevation.

When exhaust steam is insufficient to heat the water to the required temperature, live steam is admitted through a 4-in. line with a hand-operated valve. This valve is about 16 ft. above the floor, and is operated by means of a chain from the floor.

Live steam used in the heater is measured by means of a G. E. steam flow meter, and the exhaust steam used is calculated from the steam consumption of the engines, as determined by tests, and from the switchboard readings. Another method would be to measure the condensation from the heater.

The system outside of the engine room is looked after by a steamfitter who also has charge of several other buildings. When the tenants of any part of the building complain of insufficient or excessive heat, the flow of water in the drop legs is regulated to meet the requirements. Sometimes the radiators become air bound, which is relieved by the steamfitter. In case of a continued complaint from the tenant on any drop where the other tenants on the same drop are satisfied, the size of the radiator is changed. A recording thermometer is frequently used to check up the temperature in cases where complaints are made. Each branch line in the attic is fitted with a thermometer well for use in determining whether the several branches are getting the proper amount of water.

As a rule, after the valves in the drop legs have been adjusted, the only regulation necessary is to change the temperature of the water in the heater and the speed of the circulating pump, which are under the care of the engineer, and receive constant attention. Accurate records are kept of the entire system for reference.

IN AN ARTICLE on Temperature Regulation of Suction Gas, Chas. H. Herter, in Refrigerating World, shows that it does not pay to feed excess liquid into the suction pipe of ammonia compressors to prevent superheat; also that capacity of the compression and horsepower per ton of refrigeration fall off about 1 per cent for each 5 deg. F. of suction superheat, as has also been found the case in air compressor practice.

Accidents

SOME CASES WHERE SAFETY FIRST PRECAUTIONS WOULD HAVE HELPED. BY H. K. SCHOLEFELD

MORE often than not, accidents are comic rather than tragic, but at the time the comedy does not appeal strongly to the victim.

When, as a kid, I was first introduced to a hammer and chisel, and told to apply the former to the latter; I soon found that hammers had an affinity for youthful knuckles, and after an inspection of results the Boss suggested that I wear a boxing glove and chalk the head of my chisel, as offensive and defensive measures; these suggestions I adopted at the time with good effect. Thus my first lesson in the prevention of accidents made a lasting impression.

Some years later a helper whom I had sent to oil up a lineshaft had had no experience evidently, for presently a setscrew caught the leg of his trousers and saved him the necessity of taking them off. He then had more experience and less pants; but the set screw painted white, like the chisel head, might have been a safety precaution.

One day a Chinaman, whose function was to sweep floors, undertook to put a 4-in. belt on a pulley. A 4-ft. length of 1-in. pipe suited his ideas as a means to that end, so he shoved the pipe between the spokes of the pulley. At this point, the pipe became a circumstance over which he had no control; it took a turn with the shaft and on the way around caught him a blow on the head, knocking his ear off clean. We afterwards heard that he took his ear along in his pocket, expecting the doctor to stick it on again. The belt shifter and cased-in spokes came too late.

One day I started up a 12-hp. engine and left it turning slowly, just to keep it warm. The 6-in. belt from this engine passed vertically through the floor above. A ladder had been placed against the wall, about 18 in. from and parallel with this belt. Presently a newly hired man came along and climbed the ladder; being short-sighted, he took the moving belt in his hand, thinking it a pipe or handrail of some sort. The belt promptly pulled him off the ladder and dumped him between its descending side and the driving pulley, where it held him like a cockroach, hard and fast. As the engine was barely moving, it immediately stopped; otherwise he would have been crushed. We rushed over when he yelled, and I happened to get there first. By the time I reached him I had sized up the situation, and got my knife out, and I cut that belt in two like a flash.

We picked the man out and laid him out straight, and began feeling for the broken places. He got up, cussed us all thoroughly and myself in particular and proceeded up his ladder! And there I had gone and slashed a perfectly good, brand new, 6-in. leather belt. Such was human ingratitude, for not enclosing the belt. On the roof was a water supply tank, to supply our pressure line, fed by a pump on the ground floor. The tank needed attention, so I stopped the supply pump, and draining the tank climbed into it with some tools and got to work. Meantime, my man Friday came along, discovered that the tank was empty and the pump stopped, and had a fit. He started that pump immediately, and then, filled with a sense of the fullness of his virtue, started upstairs to look into the tank.

At my end of the job, I had just got my tools laid out and was standing under the pump discharge elbow, when the deluge came. Talk about a shower bath—I got mine. The pump had a rating of 1500 gal. a minute, and I got them all. A man may be wet, he can be wetter or even wettest, but I was all 3 at once, and then some.

Friday, coming upstairs with his knowledge of what a valuable man he was, met me coming downstairs, filled with thoughts of how valuable a man he was not; and he had the nerve to ask me if I was wet. That was when Friday got his. But I hadn't put any notice on the pump throttle, so I got mine.

Our 150-hp. engine runs at 90 r.p.m. The flywheel is 16 ft. diameter and has 10 spokes; consequently they are not visible when the engine runs. My wife's dog followed me to the mill one morning, and inside of 5 min. he tried to walk through the flywheel, but only succeeded in getting halfway through when a spoke knocked the life out of him. He was hit so hard he had no time even to yelp, when he became an integral part of that flywheel. At first I thought that white thing was a newspaper which had been blown into the flywheel, but presently I missed the dog and knew the worst. Now the dog was not worth anything—my wife will never read this anyhow—but the engine cannot be stopped except for a breakdown, as we run 24 hr. a day.

This happened on Monday. The weather was hot and the dog was dead, and the hotter the weather got the deader the dog got. At first we hoped to stand it until Sunday, but by Thursday we were hoping for a breakdown, and the boys were letting the oilcups run dry because they could not stand close enough to the engine to fill them. The flavor penetrated all over the ground floor and a good part of it floated upstairs.

You see a wheel that size makes considerable draft, and positively the deadest dog you ever smelled, fanned around a radius of 8 ft. 90 times a minute, has an insidious, in fact a passionately clinging disposition. No live, or even passively dead dog could possibly impress his whole being upon his human companions with such loving, nay, searching fervor.

They even kicked about it down in the ashpit. On Saturday morning we got that breakdown our hearts were set upon, and my firm belief is that one of the boys caused it purposely. But I said nothing, for I would have done the same thing myself if he had not.

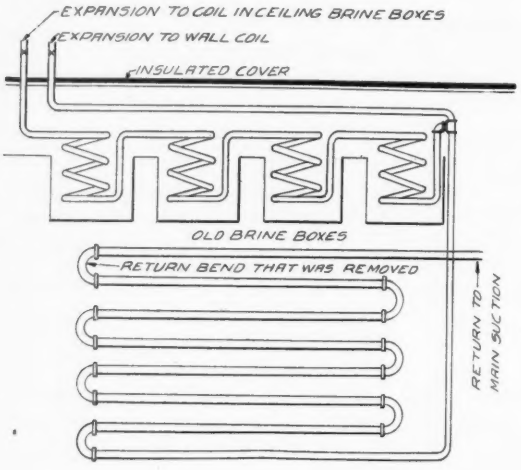
The incident was to me a most painful one. For a whole week I was the most unpopular man in the mill, they all said I put the dog in there on purpose. But I would have stood both the blame and the aroma for any length of time, even till the dog had wafted the last atom of his mortal remains to the uttermost reaches of superambient space, sooner than face the racket I got into when my wife found out what had happened to her dog. And a guard around the wheel might have saved him—and me.

THE OHIO LIGHT AND POWER CO., Fremont, Ohio, has served notice that it will not accept the new rate schedule recently adopted by the council, which calls for 5c power in Fremont, but will appeal and file its complaint with the public utilities commission of the state of Ohio

Holding Low Temperature Over Night

CONSTRUCTION AND CARE OF BRINE TANK FOR COLD STORAGE ROOMS. BY A. G. SOLOMON

IN the smaller refrigerating plants, it is customary to do the necessary operating of the ice machine during the day and shut down over night. In an unusually well built and insulated room, the temperature holds well enough; but in the large majority, some provision must be made to store the cold for use over night. Brine or calcium tanks or boxes are commonly used. The solution is brought to a low temperature while the machine is running and this cold body will hold the room for several hours.


EXPANSION TO COIL IN CEILING BRINE BOXES
EXPANSION TO WALL COIL
INSULATED COVER
OLD BRINE BOXES
RETURN BEND THAT WAS REMOVED
RETURN TO MAIN SUCTION

POOR ARRANGEMENT OF BRINE BOXES AND COILS

There is a right and a wrong construction of such tanks, a fact that was called to my attention in several places. In one place, the construction was most peculiar and the results were far from satisfactory. There were 2 storage rooms, each provided with wall coils and so-called brine boxes which were hung from the ceiling. I found they were water boxes instead of brine the greater part of the time. A description of this piping and box arrangement is necessary.

There were 2 expansion valves for each room. One of these valves fed ammonia into the banks of coils hung to the ceiling and around which the boxes were built. After the ammonia had traveled the full length of these coils, it passed through the wall coil and then to the compressor. The other expansion valve fed into the wall coil, where it came out of the boxes. By this method of piping, the wall coil could be used independently; but when this was done, the temperature of the room would go up as soon as the machine was shut down.

Upon examination, it was found that the boxes were shallow and half of the coils were not submerged. Above the boxes was a poor uninsulated covering which admitted warm air and caused the exposed coils to take on a heavy coat of frost. When the frost melted, it dropped into the brine boxes and as each box was provided with an overflow, the brine was so weak that the submerged coils were covered with ice, thus retarding their efficiency. The construction of the building would not allow of the boxes being built high enough to submerge all the coils and as the coils were of the continuous welded type, it would have been a hard and expensive job to cut them down.

It was decided to build a large brine box right in the room, hung from the ceiling, and arrange it so that there would be no dripping water getting into it. The top pipe of the wall coil was the one that connected to the main suction. We took off the return bend between this top pipe and the one next below. Then we made a ceiling coil and connected it to the 2 openings we had made by the removal of the return bend. The box was made and put in place around this ceiling coil and packed joints were used at the one end where the inlet and outlet pipes of the coil came through. This box was filled with brine which covered the coil to a depth of about 6 in. The whole thing proved satisfactory and the expansion valve handling the coils in the old boxes was left closed and a layer of shavings 6 in. deep was put on top of the covers as insulation.

The brine in such boxes must be stirred with a hoe or paddle of some kind about 3 times a week or the salt will settle to the bottom or on the coils.

U. S. CIVIL SERVICE COMMISSION calls attention to the fact that from the register of eligibles resulting from the examination for engineer, Indian Service, scheduled to be held on Oct. 11 and 12, 1916, at the places marked "(E)" in Section 2 of the Manual of Examinations for the fall of 1916, certification will be made to fill a vacancy at the Canton Asylum, S. D., and one at the Riverside Boarding School, Kiowa Agency, Okla., each at $720 a year, and other vacancies as they may occur. Applicants must be in good health and must attach to their applications statements concerning the number in their family that will require accommodations at the Indian school or agency in case they receive appointment. Only eligibles without dependants will be considered for the 2 vacancies mentioned above. Applicants must have reached their twentieth but not their fiftieth birthday on the date of examination. Information in regard to entrance salaries and conditions of employment in the Indian Service and scope and character of this examination is contained in Sections 35 and 135 of the Fall Manual. Applicants must submit to the examiner on the day of the examination their photographs, taken within 2 yr. Tintypes or proofs will not be accepted. Apply for a copy of the Manual of Examinations for the Fall of 1916 and Form 304, stating the title of the examination desired, to the U. S. Civil Service Commission, Washington, D. C.

EVERY man can master what he wishes to master if he will but wish it hard enough. Yet he who works but with his hands alone can never be a leader. What the world needs is not high-class hand work, but more high-class brain work. The top is just above; keep climbing. —T. & T. Imprint.

LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

Curing a Pump of Bad Habits

A COMMON FAULT of piston-valve simplex steam pumps is the unbalanced state of the valve piston.

With a valve rod area, at the point where the rod passes through the stuffing-box, of ½ sq. in. at 60 lb. steam pressure there is a constant pressure of 30 lb., less the friction of the packing and of the valve upon its seat, tending to push the valve toward the water end of the pump. Hence, as soon as the valve-rod packing wears slack, the pump cannot get a full stroke. The plunger vibrates rapidly through a distance of about 2 in., the valve rod being actuated in the direction of the water end by being displaced by the steam, and in the opposite direction by the linkage and tappet in the normal manner.

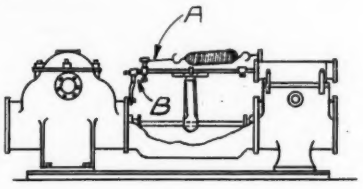


FIG. 1

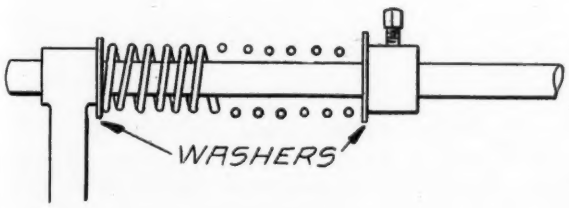


FIG. 2

FIG. 1. SPRING APPLIED TO BALANCE PISTON VALVE
FIG. 2. COMPRESSION SPRING USED INSTEAD OF ONE SHOWN IN FIG. 1

The packing must therefore be kept abnormally tight, with the attendant features of frequent tightening, repacking, waste and wear.

Figure 1 shows the application of a tension spring, attached to a rod tappet in a manner which overcomes this tendency.

Figure 2 shows a compression spring for the same purpose, this is placed at the point, B, Fig. 1, between the outer tappet and the rod bracket. The spring shown in Fig. 2 has the advantage of a neater appearance, but is otherwise inferior to that shown in Fig. 1, which looks like a makeshift. Its advantages are that the tension of the spring can be adjusted while the pump is running, and changed as occasion may demand, by altering the length of wire A.

A broken spring can be renewed without stopping, and no internal wear can occur, as in Fig. 2, where the inside of the spring has contact with the valve rod.

H. K. SCHOLEFELD.

Why the Drop of Pressure in Receiver?

AS USUAL, I read almost everything in the Sept. 1 issue with considerable interest and pleasure. Without detracting from the value of the answers given to the inquiries of A. E. E. on page 754, under the above caption, there is one other answer that I would like to offer in relation to the first inquiry of the correspondent. It is this:

Where a compound engine is properly designed and operated there will not be any degree of vacuum in the receiver; but there will be some degree of pressure above atmosphere, as indicated by a regular steam gage. This receiver pressure may range from 5 to 15 or 20 lb. per sq. in., according to the ratio of the cylinders, and the load the engine is carrying at the time.

To design an engine that would carry a receiver pressure less than that of atmospheric pressure, would not be in the interest of steam economy, and with a light load, as may occasionally happen in certain classes of work, such an engine would work at a loss. So, designers intend that some pressure above atmospheric should always be maintained in the receivers of compound engines, and this is true alike for cross-compound and tandem-compound engines. The pressure may be changed within reasonable limits, of course, without materially affecting either the economy or the smooth working of the engine. For instance, a compound engine may be so designed, for a certain load, as to carry 10 lb. pressure per square inch in the receiver; raising or lowering this pressure 1 or 2 lb. would scarcely be noticed, unless very close observations were made in each case, and then the difference would be exceedingly small. But if the pressure was increased or decreased 10 lb. or more, then there would be a difference worth noting.

If you have a compound engine designed for a certain load, there will be a certain receiver pressure that should be carried to suit that load. But suppose that you are compelled to overload the engine greatly beyond what economy can stand, then you must increase the receiver pressure in order to make the engine live up to its increased load. It becomes a question of carrying the load, not one of economy, and the engine and its designers must not be blamed for the forced conditions.

endured by the engine. I have known cases where, during certain parts of the day, the receiver pressure had to be increased from 10 lb. to 25 lb. in order to carry the peak of the load. In reality, the engine was too small for peak-load conditions, and too large for the light load periods, but it was just right for average loads, which occurred for the greater number of hours each day.

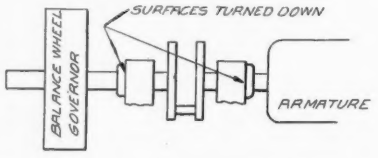
Now, when the lighest load periods were being covered the cutoff in the high-pressure cylinder was so early, and the terminal pressure in that cylinder so low, that a partial vacuum existed in the receiver at the turn. The load was so light, that the high-pressure cylinder could easily carry it alone, with a very early cutoff, without any help from the low-pressure. The remedy for such conditions is to reduce the boiler pressure so that such an early cutoff will not occur as too early cutoff is not economical. The foregoing refers to Corliss type engines.

CHARLES J. MASON.

Engine Repair

THE ILLUSTRATION shows how I overcame a knock in a center crank high-speed engine, which had a little over 3/16 in. lateral play in the main journals.

The engine could not be taken off the line till 10 p. m., so I told the engineer I would be down and give him a lift. I calipered the shaft and had 2 split set collars bored out to fit the engine shaft (couldn't get right size). On going down about 9:30 p. m., I saw that I would have to dress down the sides of the journal, so I made a cutter out of an old file. When the



USE OF SET COLLARS TO STOP END PLAY

engine was taken out of service, I clamped the set collars on the shaft and where they came together I put the cutters, one on each outside of the journal, started the engine slowly and cut down the sides until it looked pretty well, then we lined up the engine and set up the set collars on each side of the journal. We started up at 11 a. m. next day, and not a sign of trouble appeared. Of course, we fitted blocks of wood between quarter boxes to keep iron chips out of the journals.

FRED V. BROADAWAY.

Simple Demonstration of Proper Belt Practice

IN AN ice cream parlor the other evening my friend and I were served at a marble-top table. With our cream, of course, the usual glass of ice water was "thrown in" for good measure, and incidentally for quenching thirst.

As often happens my water "slopped over" onto the table top and I instinctively or habitually rubbed the glass around on the table top so as to create a "smear."

I soon drained my glass and placed it back on the table in my puddle of water and then, land sakes! it sailed away on that thin film of H_2O.

That was a new one for me. The table was almost perfectly flat—so flat that my water puddle didn't run off. Yet, my bulky and fairly heavy glass slid along as though it were on rollers on a 10 per cent grade.

Investigating, I found that the bottom of the glass was constructed as indicated by Fig. 1—it was slightly concave—and then I understood. Air pocket. No contact between glass and marble. Slip.

As it happened, my friend's glass was flat-bottomed,

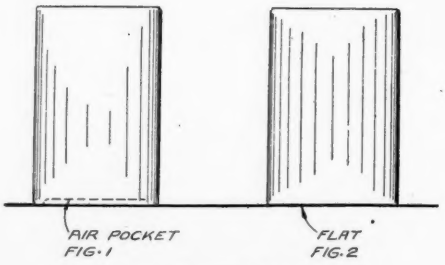


FIG. 1. GLASS WITH AIR POCKET
FIG. 2. FLAT BOTTOM GLASS

like Fig. 2, and I gave it a trial; but it wouldn't slip at all. Quite a push was required to make it slide. No air pocket. Plenty of contact between glass and marble. No slip.

Again and again I experimented with both glasses, and each time results were the same—just as already told. Figure 1 slipped every time. Figure 2 didn't.

Now we will jump over to the old question, "Which side of the belt should run next to the pulley—the hair side or the flesh side?"

The above experiment illustrates the dangers of air pockets such as are liable to occur with the rough flesh side next to the pulley. Using the smooth hair side against the pulleys there are no air pockets.

I would like to have readers try the experiment some time. You'll be amazed. And in the future you will run the rough side "outside."

N. G. NEAR.

Some Much Needed Overhauling

WE HAVE a 15-ton, steam-driven refrigerating machine working on 2 storage rooms, keeping them at 32 deg. F. (0 deg. C.). It has been in operation nearly 7 yr., and there has been no chance in that time to stop the machine long enough for a thorough overhauling. From men here before me I hear that the machine has never been working properly since the day it was installed, the rods heating up and always running so warm you could hardly touch them. The bearings pounded and knocked and the ammonia compressors clicked loudly.

It had been the habit before my time to run the machine 85 r.p.m., and carrying 5 or 6 lb. back pressure. I took up on the bearings, when taking charge 3 yr. ago, and slowed the machine down to 60 r.p.m. and carried about 12 to 15 lb. back pressure. It improved the operation of the machine then.

This last winter, having put in a new storage room with means for outside refrigeration in winter, we had a chance to stop the machine and overhaul it. We first took the steam piston out and examined it and had the

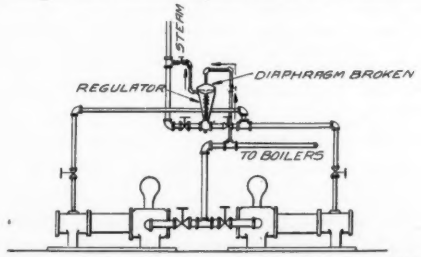
rod reground, also the valve stems. When we replaced them, we put metallic packing in them. Then we ground in the Corliss valves, put them in good shape and lined up the piston. All bearings were taken apart; it was no wonder that they pounded. At some time they had run hot, and the babbit had wiped all over oil grooves so they did no good; they were scraped to a good fit and replaced. Then the ammonia cylinders were looked at. They were found to be out 1/16 in., and that accounted for the packing burning and the rods diving in the glands sidewise each stroke. This fault was corrected by jacking up the cylinders and placing strips of tin where it was low, to bring it in line.

The ammonia piston was found to have ¾ in. of clearance. (In 7 yr. running there was a lot of work lost there.) The pistons were taken out and rods reground and lined up, ready for a tryout. When the machine was started up it was worth all the hard work to hear the ease with which it operated, not counting the increase in work by decreasing the clearance from ¾ in. to about the thickness of 3 sheets of paper. It had operated at 85 r.p.m., but got only about 75 r.p.m. in as work.

C. M. Bourcy.

Broken Diaphragm Causes Pump Shutdown

We have 2 boiler feed pumps which seldom give us any trouble, but suddenly one day the pump that was working slowed down so that it would not pump sufficient water to supply the boilers. The fireman shifted on to the other pump, which did likewise, barely moved. The pressure in the boilers had to be lowered to 60 lb. in order to force city water into the boilers. Then we went through the same ordeal that all men do with a



FEED PUMP AND REGULATOR CONNECTIONS

balky pump. On taking off cylinder heads and examining plungers, valves and valve gears, we found everything about the pump in good order. Then we examined the feed line to the boilers, which was found all right.

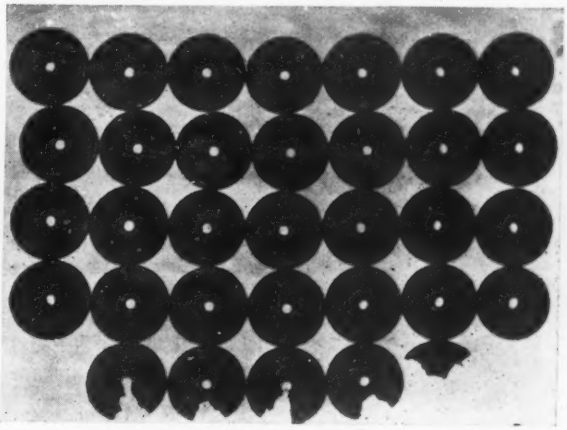
An examination of the steam line was left until the last, as we could not see how that could possibly stop up; but, on opening a bleeder, there did not appear to be much pressure. We knew something was wrong here. So the stop valve was closed, and water began to flow out at the bleeder. The trouble was located then, as indicated in the drawing. The diaphragm in the regulator had broken through, letting the water through into the steam line to the pumps, condensing the steam sufficiently to slow down the pumps.

Evidently the diaphragm had been leaking for some time, as the steam pipes were coated with hard scale and had to be taken out and renewed.

Wilson Race.

Short Service of Pump Valves

In the accompanying illustration is shown a set of 5-in. soft-rubber pump valves which gave very limited service. The pump in which the valves were used is one ordinarily kept for emergency elevator service in case a motor-driven unit becomes disabled; it is also coupled up as a flood pump in case of high river, and is only occasionally put into service, sometimes standing for a year without being used. The valves shown in the cut were placed in the pump about 2 yr. ago, when they were worked for 2 days, and then not again for 9 mo.; after that, the pump was again out of service for over a



CONDITION OF PUMP VALVES AFTER LESS THAN 100 HR. OF SERVICE

year, until late this spring, when the occasion arose to operate it for a week. Before the end of the first day's run it was blowing badly; that night the valves were examined and 2 of them found to have a section blown out, and were replaced by some old ones on hand. Before the end of the next day's run, it was blowing again, so that night a complete new set of valves were installed, the old ones not having done 100 hr. of service. The question is, do rubber valves deteriorate more rapidly when standing idle after short intermittent services than they would if used continually?

L. M. Johnson.

Cleaning the Engine Room Clock

It was at a small municipal power station. The old clock in the engineer's office had stood silent for many months.

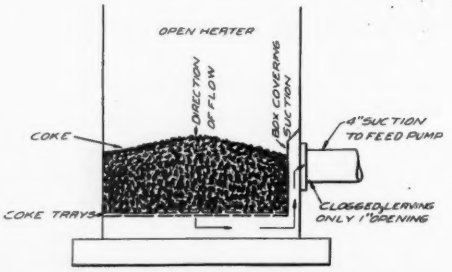
"Let's clean it," I said, "by a simplified and practical plan." Here are the directions we followed: Take the movement from the clock and place it in a kettle of boiling water; let it remain in the water for 15 to 30 min., thoroughly scalding, and upon removal place in the sun or a warm place to dry. When fully dried, oil the movement carefully before placing back in the frame. The excessive scum and dirt which accumulate in the water from a clock movement that has not been in recent use, show the need for a thorough scalding.

The old clock in the engineer's office hasn't given any trouble since.

L. R. W. A.

Clogged Heater Outlet

THE ACCOMPANYING sketch shows how a partially plugged water outlet of open feed water heater causes continuous trouble. When the load would reach a certain point, the feed pump would begin to hammer from lack of water; then the fireman would let cold water in the suction, which would relieve the situation for a while.

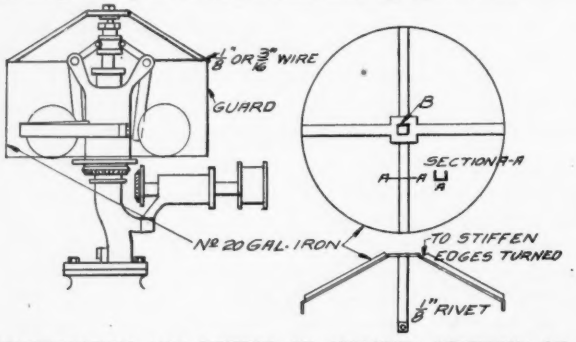


LOCATION OF CLOGGED SUCTION PIPE

This performance was continued every little while until load dropped off. Many suggested that the heater was too low, the water level in the heater being only 4 ft. above center of pump plunger; but as the temperature of the water was only about 130 deg., we assumed that there was other trouble. Upon taking off the box that covers the suction, we found that solids had accumulated until there was only 1 in. opening where the 4-in. suction line connected to the heater. After this was cleaned out the trouble ended. J. A. HAWKINS.

Governor Oil Guard

IN ORDER to prevent the unsightly appearance given walls and floors bespattered by the oil thrown from fly-ball governors, I constructed a metallic guard of the form shown in the accompanying figure. The side of this guard is made of No. 20 galvanized iron stiffened with a wire edge; galvanized iron strips having bent-over edges, as shown, are riveted to the side sheet, forming a support for this. At B is cut a hole, either square or hexagonal, so as to drop readily over the nut at the top of the stem. The diameter of the guard depends upon the maximum throw of the governor balls; its height may be made to suit existing conditions.



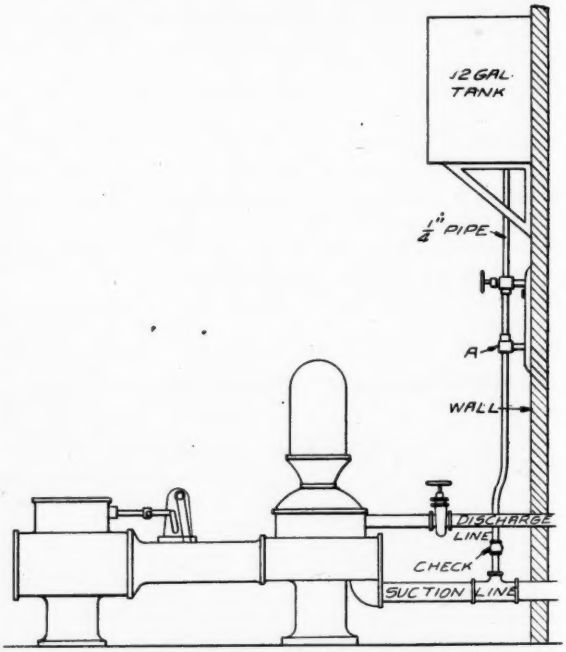
CONSTRUCTION AND METHOD OF APPLYING GOVERNOR OIL GUARD

Instead of being thrown upon near-by objects, the oil will collect upon the inside of the guard and can be wiped off at will. The assembly is extremely light, nothing to disconnect, just lift off, oil governor and replace. JOS. WEBSTER.

Compound Feeder

RECENTLY, I saw a neat and ingenious device for feeding compound to boilers, consisting of a 12-gal. square tank made out of sheet iron supported on the wall by means of braces. In the bottom of the tank a small steam coil was installed to keep the compound hot and agitated at all times. The sight feed glass and connections marked A in the sketch were taken from an old 2-qt. lubricator, and its operation needs no explanation.

On the compound feed line near the tee where it connects into the pump suction, a check valve is installed to prevent any excess pressure reaching the compound tank and wrecking it or blowing all the compound out into the pump room. The amount of compound used can be regulated by the handwheel to any required number of drops per minute, thus delivering the compound at a uniform rate throughout the day, which is, in my estimation, the ideal way of feeding compound to boilers.



CONTINUOUS COMPOUND FEEDER

C. E. ANDERSON.

NOVA SCOTIA firms have been found by Consul Chas. M. Freeman, of Sydney, to use much packing from the United States. The greatest demand is for sheet and piston rod packing, the sheet packing being largely Canadian make, but the piston packing coming directly and indirectly from the United States.

Most of the large firms in Nova Scotia buy through a purchasing agent, and this is the official who should usually be addressed. Such concerns as the Dominion Iron & Steel Co. and the Nova Scotia Steel & Coal Co. of Sydney, Dominion Coal Co. of Glace Bay, and the Inverness Railway & Coal Co., at Inverness, are among the large users.

The terms on which packing is bought by dealers and users is usually net cash 30 days, f.o.b. shipping point. The Bureau of Foreign and Domestic Commerce has a list of dealers and users in the Sydney consular district.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Turbo-Generator Employed for Power Factor Correction

ONE DIVISION of our power plant consists of the following equipment: One 1000-kv.a., 240-v., 2-phase, 25-cycle engine type alternator driven by a cross-compound condensing Corliss engine and 1 1200-kv.a. low-pressure steam-turbine-driven alternator, the turbine utilizing low-pressure exhaust steam from an external source, also connected by a reducing valve to the high-pressure headers for use in an emergency.

Each machine has its individual condenser and generators operating in parallel.

The low-pressure steam supplied to the turbine throughout the day varies in quantity and pressure, and the engine is conceded to be more economical than the turbine when the latter is using high pressure or live steam. Thus, in the trial of efficiency, the load is shifted from the turbine to the engine, and vice versa, according to the supply of low-pressure steam.

This results at times in overloading the engine generator to such an extent that the armature insulation has been slightly damaged.

We have a power factor indicator connected to leads of each machine, and it has been our instructions to maintain equal power factor on each machine regardless of the load distribution. Our connected load is far in excess of our average load—that is, the greater part of the motors are working at far less than their rated horsepower. All motors supplied by these 2 machines are of the squirrel-cage induction type, which requires nearly constant magnetizing current at all loads, resulting in a low power factor upon the system.

At such times as stated above, instead of maintaining equal power factor on each machine, why not operate the engine generator at or near unity power factor, allowing the alternator series field rheostat to remain "set" as long as the power factor on that machine remains near unity, regulating the voltage and carrying all of the wattless current upon the turbo generator? This would relieve the engine generator from overheating and, at the same time, if I have the correct theory, would require little more steam consumption by the turbine. But can this be accomplished without increasing the total wattless current, or will a cross current be set up between the alternators, tending to throw them out of step? Such practice, I understand, will tend to distort and demagnetize the alternator fields, but will it do so to such an extent as to impair the regulation?

One other condition which is here met with, that may prove detrimental to such practice, is the method of transmitting low-pressure steam to the turbine. Being transmitted a considerable distance, the steam passes through various receivers and separators, the steam traps on some of which are altogether too small and others not always working effectively, resulting in slugs of water being thrown over into the turbine, at times, in sufficient quantities to cause that machine to drop all of its load and cause its generator to run for the time as a motor.

Summing up all stated conditions and any others that may be unforeseen by me, can the method here outlined be recommended in preference to the method of operation now in use? G. D. S.

A. It is entirely feasible for you to allow the turbo generator to supply the wattless current and the cross-compound engine to operate at a high power factor. This method of operation would be a modified form of power factor correction by means of a synchronous condenser and should give you no trouble at all.

It will not be advisable, however, to try to obtain 100 per cent power factor on the engine generator, as the last few per cent of power factor improvement will require greater expenditure of exciting current on the turbo alternator, and so make its regulation rather unstable.

Unless the slugs of water you refer to are of such magnitude as to pull the turbo generator out of step (and from your letter this has apparently not been the case), they will not greatly affect the successful operation of the machines as you propose.

There will be no increase of wattless current except the little extra "synchronizing current" which will flow between the machines due to the turbo running at almost no load. It will simply mean a shifting of the induction motor magnetizing current from the engine generator, leaving it free to carry its full-rated load without overheating. If the field excitation of the turbo be excessively increased, it will cause the engine generator to operate with a leading power factor. This should be avoided.

Increasing the power factor of the generator will not demagnetize its fields, but will, on the other hand, strengthen them and make its operation better—i.e., improve the regulation. A generator operating at 100 per cent power factor has its fields neither magnetized nor demagnetized by the stator current, but has its flux distorted in a manner exactly similar to the phenomenon known as "cross magnetization" in direct current machinery.

If the generator delivers a lagging current, the wattless component of this opposes the field magnetism, thus requiring an increase of exciting current to maintain constant voltage. On the other hand, a leading

current has a wattless component which assists the field—thus permitting a decrease of exciting current.

The only power required to drive the turbo if delivering a purely wattless current, will be that used up in supplying friction, windage, copper and iron losses. These will depend upon the design of the machine.

V. E. JOHNSON.

Relative Economy of Gas-Producer Plants

ARE GAS-PRODUCER power plants more economical than steam power plants for factory operation?

2. How can the exhaust from gas engines be employed for heating purposes?

3. What is the device that will make the heating of a factory possible where a gas producer is employed? Would such an arrangement add to the cost of fuel?

C. H. C.

ANSWERS

WHETHER a gas-producer power plant will be more economical than a steam plant depends much on the conditions in the plant. If the demand for steam for heating is greater than for power, then the steam plant will be the more economical, because you will have to furnish the heat for the buildings anyway, and the slight extra heat required to make high-pressure steam for running steam engines will not add materially to the cost, while the cost of a gas engine producer plant as compared with a simple steam engine and boiler plant will be considerably greater. If, on the other hand, the steam required for power is considerably greater than that required for steam heating, it is probable that the gas engine power plant will be the more economical.

2 and 3. The exhaust from gas engines has been used for heating buildings in 2 ways: If the buildings are not large, it can be done by circulating the exhaust gases through heating coils and blowing air over these coils for indirect heating of the building. This will hardly be suitable for a large store, however, and the only practical method would be a hot water heater, by which the heat is taken up from the exhaust gases by means of water circulating through tubes, and this water is circulated by pumps to hot water radiators throughout the building. A special heater for such purpose is made by The Sims Co., and the Williams Tool Co., both of Erie, Pa.

Of course, putting such a feed water heater on the exhaust end will raise the back pressure on the gas engine and cut down its power slightly; but if the heat furnished from the engines is more than that required to heat the building, this will not add materially to the cost of the fuel.

A. L. R.

Coast Artillery Corps Examination*

THE LEAD SCREW of a lathe has ½ in. pitch and is right-handed. The set of change wheels belonging to the lathe consists of the following number of teeth: 20, 25, 30, 35, 40, 45, 50, 60, 70, 80, 90, 100, 110 and 120.

Devise suitable trains to cut (a) a right-handed screw of 8 threads to the inch and (b) a left-handed screw of 12 threads to the inch.

A. If the lathe is simple geared, and the stud runs at the same speed as the spindle, select some gear for the screw, and multiply its number of teeth by the number of threads per inch of the lead screw and divide this result by the number of threads per inch to be cut. This will give the number of teeth in the gear for the stud.

Let us select a 30-tooth gear for the screw. Multiplying 30 by the number of threads per inch of the lead screw, or 2, gives us 60. Dividing this by 8 under (a) we obtain 7½ which, due to being a fractional number, cannot be used. Let us then take the 40-tooth gear for the screw; multiplying 40 by 2 and dividing by 8 gives us 10. This, however, is too small.

Again trying, we will take the 80-tooth gear. Two times 80 is 160; dividing by 8 we obtain 20. Therefore use the 20-tooth gear for the stud.

In a like manner may the gears for the 12-thread-to-the-inch be calculated.

If the lathe is compound, select at random all the driving gears, multiply the numbers of their teeth together, and this product by the number of threads to be cut. Then select at random all of the driven gears except one; multiply the numbers of their teeth together, and this product by the number of threads per inch in the lead screw. Divide the first result by the second, to obtain the number of teeth in the remaining driven gear. Or, select at random all the driven gears. Multiply the numbers of all their teeth together, and this product by the number of threads per inch in the lead screw. Select at random all the driving gears but one. Multiply the numbers of their teeth together and this result by the number of threads per inch of the screw to be cut. Divide the first result by the last to obtain the number of teeth in the remaining gear.

Let us assume having a compound lathe and that the required number of threads to be cut per inch is 8, as in (a) above. Let us select the 20 and 30-tooth gears for driving. Multiplying 20 by 30 by 8 we obtain 4800. The number of threads per inch in the lead screw is 2. We will then at random take the 40-tooth gear as one of the driver gears. Two times 40 is 80. Dividing the first result by the last, or 4800 by 80, we obtain 60 as the required number of teeth in the remaining driven gear.

When cutting a left-hand thread, the tool carriage is driven toward the tail stock. For cutting a right-hand thread, this direction of travel must be reversed so as to cause the tool carriage to travel from the tail stock.

8. (a) What is the essential difference between a planer, a shaper and a milling machine in respect to the cutting tools?

(b) Explain the process of making new bronze bearings for crank shafts.

(c) How may badly scored bronze bearings be repaired?

(d) State how to repair a pin hole in a defective casting of a steam engine cylinder.

A. (a) Planers and shapers employ cutting tools the general form of which are not unlike those used on lathes, that is, the tool consists of a short length of tool steel, one end of which is forged and ground to the required shape. Cutting tools of milling machines, however, consist of a series of cutting edges of the required form and size formed upon the periphery of a small revolving disk.

(b) The making of bronze bearings for crank or other shafts is one rightfully belonging to a foundry

*Continued from page 794, Sept. 15 issue.

equipped for such work. The process in general would, briefly stated, consist of making the mold by means of the necessary pattern, casting and machining to required size and form.

(c) Badly scored bronze bearings may be satisfactorily repaired by placing them in a lathe and cutting away sufficient metal to remove all traces of damage. This, however, can only be done when the scoring is not of any great depth. If it is found that the scoring is quite deep, cutting away the required amount of metal may cause trouble in obtaining the necessary fit, and in such a case it might be best to remove sufficient stock and insert a liner, securing it to the body of the bearing by means of dowel pins.

9. Solve; $\frac{x}{a} + \frac{y}{b} = 1$ ..... (1)

$\frac{a}{x} + \frac{b}{y} = 4$ ..... (2)

Transposing (1) and solving for x we have

$$x = a\left(1 - \frac{y}{b}\right)$$

Substituting this value of x in (2)

$$\frac{a}{a - \frac{ay}{b}} + \frac{b}{y} = 4;$$

Reducing first member to common denominator we have,

$$\frac{ab}{ab - ay} + \frac{b}{y} = 4;$$

Reducing left hand side of equation to common denominator,

$$\frac{by + b^2 - by}{by - y^2} = 4, \quad \text{or} \quad \frac{b^2}{by - y^2} = 4;$$

Transposing we obtain quadratic equation

$$b^2 - 4by + 4y^2 = 0, \quad \text{or} \quad (b - 2y)^2 = 0$$

We therefore have $y = b \div 2$

Again transposing (1) but solving for y this time,

$$y = b\left(1 - \frac{x}{a}\right) = b - \frac{bx}{a}$$

Substituting this value of y in (2) we have,

$$\frac{a}{x} + \frac{b}{b - \frac{bx}{a}} = 4;$$

Solving second member on left-hand side of equation for common denominator, and canceling like quantities,

$$\frac{a}{x} + \frac{a}{a - x} = 4, \quad \text{or} \quad \frac{a^2 - ax + ax}{ax - x^2} = 4, \quad \text{or}$$

$$a^2 - 4ax + 4x^2 = 0, \quad \text{or} \quad (a - 2x)^2 = 0$$

Therefore, $x = a \div 2$

CHECK

Substituting values of x and y as just determined in (1) and (2)

(1)... $\frac{\frac{a}{2}}{a} + \frac{\frac{b}{2}}{b} = 1$ (2)..... $\frac{\frac{a}{2}}{\frac{a}{2}} + \frac{\frac{b}{2}}{\frac{b}{2}} = 4$

$\frac{x}{2x} + \frac{y}{2y} = 1$ $\frac{2x}{x} + \frac{2y}{y} = 4$

FIG. 5. SOLUTION OF PROBLEM 9

(d) The method to be recommended for repairing a pin hole in a defective steam engine cylinder casting depends upon the nature of the defect. If the pin hole extends from inner to outer walls and causes a leakage of steam, enlarge the hole on the outside of the cylinder by drilling to a depth of about ¾ in. with a ¼-in. drill. Tap, and insert a threaded plug, cutting off the head of the plug flush with the outer surface of the casting. Before inserting the plug, wet the threads of both plug and casting with water so as to cause the formation of rust, which will prevent leakage and retain the plug in place.

Should the hole not extend through the casting, however, the repair may be made by enlarging the hole on the inside of the cylinder by drilling as directed above, filling the hole thus drilled with babbit and scraping smooth as to be flush with the walls of the cylinder.

A pin hole not extending through the casting may, however, in the majority of cases be ignored.

9. Solve: $\frac{x}{a} + \frac{y}{b} = 1.$

$\frac{a}{x} + \frac{b}{y} = 4.$

A. See Fig. 5.

10. An unknown force combined with one of 128 lb. produces a resultant of 200 lb., which resultant makes an angle of 18 deg. 24 min. with the known force. What is the value of the unknown force?

A. To solve this problem will require resorting to the use of trigonometry.

Referring to Fig. 6, we have OB representing the force of 128 lb. and OC at an angle of 18 deg. 24 min., the resultant of 200 lb.

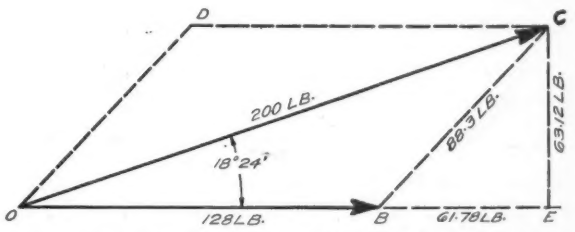


FIG. 6. THE INCLUDED ANGLE IS 18 DEG. 24 MIN. AND THE 2 SIDES ARE REPRESENTED BY THE FORCES OF 200 LB. AND 128 LB.; FROM TRIGONOMETRY WE FIND THE UNKNOWN COMPONENT EQUAL TO 88.3 LB.

To complete the parallelogram of forces, join C and B. Then, parallel to OB draw DC, and parallel to BC draw OD, the unknown force. Due, however, to CB being equal and parallel to OD, it also may be employed to represent the unknown force. We therefore have triangle OCB, 2 sides and the included angle of which are known.

From C drop a perpendicular CE to OB extended, forming right-angled triangle OCE.

From trigonometry, CE is equal to OC times the sine of the included angle, or 18 deg. 24 min. OC is equal to 200 and the sine of 18 deg. 24 min. is 0.3156; CE is, therefore, equal to 63.12.

OE is equal to the product of OC, or 200, times cosine 18 deg. 24 min., or 189.78.

BE is equal to OE minus OB, or 189.78 minus 128, or 61.78.

CE is equal to 63.12 and BE is equal to 61.78.

Therefore, BC is equal to the square root of the sum of 63.12 squared, plus 61.78 squared, or 88.3. lb.

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Boiler and License Laws

Safeguarding of the public is becoming increasingly popular with legislative bodies, as is evidenced by laws covering liability for injuries to employes, limitation of hours for women and children and similar enactments proposed and achieved.

Interest in boiler inspection laws both state and municipal and in license legislation for engineers is also increasing, as indicated by correspondence and by discussion in papers and before meetings of societies. Progress so far made, and failures to secure passage of bills indicate that separation of boiler laws and license laws is more favorable to both, since diverse elements are interested in the passage of the two kinds of legislation. The American Uniform Boiler-Law Society has made good progress during the year in its commendable effort to secure consideration and where possible adoption of the A. S. M. E. code in various states, but has found that for best success the work must not be joined in any way to license legislation. Recent action in Ohio looks to a movement for uniform codes for boiler inspection, and it would seem that this movement would properly parallel that for the uniform code.

License laws for engineers, while as important for public safety, will be advocated by many people not vitally interested in boiler code or inspection laws and vice versa. Hence, while co-operation and common interest will be found at many points, joining the two provisions in a single bill may result in unfavorable action on both, where one or the other alone might have succeeded.

It is evident that at the present time it is desirable to have a complete record available of boiler and license laws, court decisions and proposed bills which may be available for consultation by anybody interested and the N. A. S. E. has proposed the preparation of such a compilation in regard to license laws for the use of its members. Practical Engineer will endeavor to render this service for its readers, and in this cause asks their co-operation by sending to us copies of such laws as they may have, either state or city, and of proposed bills which have failed to become laws. Also of court decisions, amendments to laws and related facts as to enforcement which should be included in a complete record. Such data will be copied and returned to the sender if so desired. This compilation will cover boiler construction, installation and inspection laws and ordinances, smoke prevention ordinances, engineers' license laws and ordinances and requirements for electrical installations and for electrician's license.

Shall we have the assistance of all for the good of all?

Your Winter Evenings

Nobody has gained success by his personal accomplishments without paying for it. To be an engineer worthy of the name is a personal accomplishment and must be paid for in the sweat of the brow; money cannot buy this accomplishment, so those who would reach the pinnacle of success in this profession have no alternative, the cost is hard work and the sacrifice of time.

But if you love the work, the time you spend is a pleasure for which you are paid in personal advancement.

Now that cold weather is approaching and the home is doubly inviting, to get the most for one's time, we know of no better evening occupation than the systematic study of some branch of his every-day work. Many of our readers accepted the offer we made last year to outline a course of reading for winter evenings and the editors of Practical Engineer again make the offer. To be of greatest help to you, we should know about how far your schooling has gone and the subject you desire to study with the ultimate aim you have in view.

To be of greatest value, such a reading course should be followed persistently according to a regular program and at the end of a few months' study you will be surprised at the amount of ground you have covered and the grasp you have gained of the subject; you will have greater confidence in your work and be in better position to solve the perplexing problems of your plant.

Editorial Comments

Although recent developments in the mechanical equipment of modern central power plants have been marked, the electrical equipment has kept pace so that more reliable service is rendered, regulation is more nearly perfect, dangers have been lessened, lightning protection has been perfected, and many other electrical features have been improved. In the leading article of this issue, a description of the electrical features of the Essex plant is given as it represents the most modern power plant practice and completes the detailed description of the plant, being the third article of the series.

Boiler efficiency is influenced greatly by the condition of the heating surface; if this is covered with an insulating layer of soot, transmission of heat cannot be so rapid as when a clean surface is maintained. Soot accumulates with comparative rapidity, and to keep the surfaces in good condition, some means must be provided to remove the soot frequently during operation. To acquaint our readers with modern means for doing this work, an article appears in this issue describing soot blowers for various types of boilers.

Methods and means of lubricating bearings come into that class regarded as "necessary evils," and as such the tendency is to neglect not only to provide efficient means for handling lubricants, but also to reclaim used oils and to secure those lubricants best suited to the bearings employed. Two articles in this issue bear on this subject, and should be of aid to engineers, particularly in small plants where scientific methods of handling oils have not been installed.

By many engineers, the hot water heating system is considered applicable only to residences or institutions where continuous heat is required. This is not necessarily true, as there are a number of office building installations which give the best of results. One of these is described by Mr. Hawkins, who also gives some practical pointers in regard to the operation.

Safety first, last and always, is the moral of the incidents related by Mr. Scholefeld of accidents he has witnessed and he brings to our attention some of the easily applied devices which may be used to prevent accidents and serious injuries.

So important is it that the service of power plants be uninterrupted and the efficiency high, that it is becoming common to install apparatus for purifying and conditioning air used in cooling generators and transformers. This issue contains a description of apparatus for this purpose, and in reading it we are reminded that apparently unimportant details of operation affect the efficiency of machinery to considerable extent.

IN "RUSSIA," a journal published by R. Martens & Co., of New York City, in the interest of increasing trade with Russia, Professor K. V. Kirsk, president of the Moscow Fuel Committee, proposes and urges the building of electric generating stations in the region of peat and low grade coal beds to supply electric power for the industries of Moscow. At present, and in the past, the chief fuels for steam power, which has been the main industrial dependence in Moscow and the surrounding region, have been oil, and coal from the Donetz Basin. These sources cannot be relied on in future to supply the needs of the Moscow district; but there are ample peat beds and deep veins of low grade coal which can be used on the spot, but not economically transported. Electricity, generated at the fuel sources, could, however, be transmitted to the factories and relieve the shortage of high grade fuel, as well as conserving the supply, and this remedy is urged by Professor Kirsk for immediate adoption.

U. S. CIVIL SERVICE COMMISSION announces an examination, Oct. 3, for senior highway bridge engineer, to fill vacancies in the Office of Public Roads and Rural Engineering, Department of Agriculture, at salaries ranging from $2400 to $3300. Applicants must show that they have had not less than 4 yr. of preliminary engineering experience or that they are graduates in civil engineering from a recognized college; also, that they have had not less than 7 yr. of responsible engineering experience, of which not less than 4 must have been in responsible bridge engineering, and not less than 2 in responsible highway bridge engineering. Applicants must have reached their thirtieth birthday on the date of the examination. Apply for Form 1312.

U. S. CIVIL SERVICE COMMISSION announces an examination for highway bridge engineer, on Oct. 4, to fill vacancies in the Office of Public Roads and Rural Engineering, Department of Agriculture, at salaries ranging from $1800 to $2100. Applicants must show that they have had not less than 4 yr. of preliminary engineering experience or that they are graduates in civil engineering from a recognized college, and that they have had at least 3 yr. experience in bridge engineering, of which at least 1 yr. must have been in practical highway bridge engineering. Applicants must not have reached their fortieth birthday on the date of the examination. Apply for Form 1312.

Correction

IN THE formula for calculating the loss resulting from uncovered pipe, submitted in the article on Insulation which appeared in the Aug. 15 issue, the old value for the latent heat of evaporation, 965.8 B.t.u., was erroneously used. According to the late Marks and Davis's Steam Tables, this value is 970.4 B.t.u.

At the Northwest Gate

WITH MINNEAPOLIS FOR A WEEK OF STUDY, WORK AND FUN

WELCOME! It was evident everywhere from the first day to the last. The bands played it; the Mayor voiced it; the signs flaunted it and Minneapolis engineers did it. There could be no doubt that the city and its hospitable citizens were glad to have the 1916 convention of the N. A. S. E. and that the engineers were glad to be there. On the site which 67 yr. ago was an Indian reservation, the delegates, 400 strong, with as many more representatives of manufacturers foregathered to hear of progress and possibilities in engineering, to plan for the coming year of organization work and to enjoy the pleasures of social activity and sight seeing.

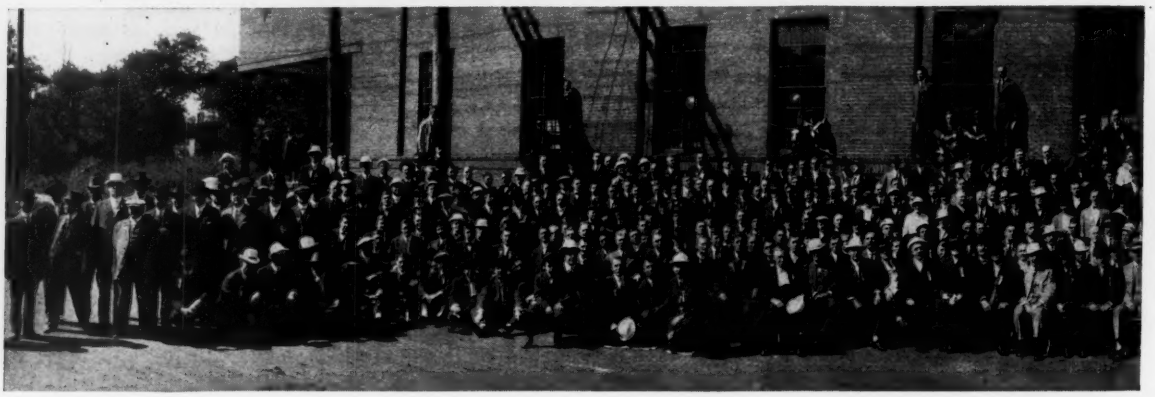
As usual, Monday was a day of preparation, the glad hand and joyous Hello! and reception to new acquaintances and old likewise, as usual, the State Association joined forces with the National convention and started its meeting on the 10th, Chas. A. Byrne presiding. The keynote of this state meeting was further activity toward safeguarding life by boiler inspection laws and license laws to ensure that steam machinery be in the charge of competent men. This was first emphasized by Hon. Thomas Frankenson of St. Paul, who eulogized organization for the sake of preparation for industrial fitness and endorsed the enactment of laws for inspection and license. He is candidate for lieutenant governor, hence, if elected, will have much power to aid in passing such laws.

National President Walter H. Damon, in replying, expressed the belief that state associations should be given control over much of the work now carried on by the National Association, thus adding to the importance of the state organizations and their meetings, and bringing local associations closer together by their co-operation in the state work. He advocated the formation of district associations to take in several states, where the locals of a single state were not strong enough to support a state organization.

John W. Lane, speaking of efficiency, called attention to the fact that recent progress consists largely in getting in common practice results that were obtained years ago in isolated cases by specially able men; raising the average of performance to the standard set by these unusual pioneers, by adopting their principles and practices and making them common property.

National Secretary F. W. Raven, spoke of the value of conventions in giving opportunities for travel and observation, and for rubbing up against other men, giving breadth of view and appreciation of their opinions and methods.

State President Johnson then took charge, speaking of the work in Minnesota for license law and progress, and reported 7 locals in the state association with 413 members. Report of State Deputy Hayes showed that effort to repeal the present unsatisfactory inspection and license laws and enact better ones had failed partly because of lack of unanimity among engineers. General discussion brought out agreement that the present laws are mostly an excuse for political patronage, an inspector being appointed for each of 50 counties without regard to need or fitness; it was agreed to proceed with the bill presented 2 yr. ago and ask each local association to approve, amend or reject so that unanimous action may be reached, and $200 was appropriated for the work of the license committee.



GROUP OF ENGINEERS, EXHIBITORS AND VISITORS

Credentials showed 38 delegates in attendance from the state and at Monday's meeting St. Paul was chosen for the 1917 state convention. Officers elected were: President, J. A. Johnson of St. Paul; vice-president, Geo. Schreiber of Mankato; secretary, J. F. Gould of Minneapolis; treasurer, H. S. Hozen of Minneapolis; conductor, J. Q. Adams of Duluth; doorkeeper, F. C. Donath of Winona; state deputy, T. S. F. Hayes of St. Paul.

This work was completed Monday morning, and the rest of the day was punctuated by the arrival of groups

of delegates from west, south and east, business of registration and getting located and the opening of the Supply Exhibit and officers' reception. After which to bed at an early (?) hour to rest for the real work of the morrow.

It Opens

Promptly. Everything President Damon does has Promptness for a middle name. When his company orders another 20,000 kw. capacity to be installed and ready to deliver power at a certain time, at that time it is ready and delivers power. So at 10 a. m. on Sept. 12, 1916, that convention opened. The delegates did not march from the West Hotel to the Pence Building, for a drizzling raw rain was turned on by the weather man under the mistaken idea that it was a convention of prohibitionists. Funny idea that! However, the delegates were there, also Governor J. A. A. Burnquist, Mayor W. G. Nye, L. F. Blyler of the Commerce Association, Rev. James E. Freeman, and Chairman J. M. Williams of the local convention committee, who had the honorable and responsible task of keeping things moving in order and on time. For Damon was watching.

the effect of organizations in training men in discipline and cooperation, a training needed for his success as a worker and a citizen.

Rev. Freeman, in closing, warned against living in isolation, thinking only of personal interests and giving nothing to the common weal, and showed that such living cannot make an efficient man even in the lower things of material prosperity.

It Was Opened

So President Damon was given charge, and proceeded to appoint the necessary committees and to announce the meetings would begin on time, the next one starting at 2 p. m. Then everybody went to luncheon.

After Eating

Everybody felt refreshed and ready for business, and gave sharp attention to the president's report which was presented at 2 p. m., sharp. This commented on the affairs of the organization journal, reported new slides and lectures prepared by the educational committee and an arrangement whereby members can have the steam

AT THE NATIONAL CONVENTION OF THE N. A. S. E.

Oh! yes. There were, of course, the other national officers, to do their bits, and did them, but Williams was running that particular part of the program.

Governor Burnquist extended cordial and courteous welcome to the state, and expressed approval of the educational purpose of the Association and the effort for a reasonable license law.

This welcome was furthered by Mayor Nye, who spoke for the city, telling of its attractions, its institutions and its prosperity, and bidding all be joyful in their stay there. Humor and statistics were blended by Mr. Blyler in telling of the business, the scenery, the importance of the state and city and in trying to give an idea of the hard work of the committee to make the convention a success, a work, by the way, with which Mr. Blyler has heartily cooperated.

Responses were made by the national officers, President Damon reminding the convention that a year ago Minneapolis was promised to the engineers and now they were here to take it—for a week. Vice-President Kerley told of the educational objects of the Association, and of its accomplishment, and John W. Lane emphasized courses of the International Correspondence Schools at 25 per cent discount. It recommended that state associations have charge of educational work so that each state may have it specially fitted to its needs for license or otherwise. Changing the educational committee from three to five as voted by referendum last year was not approved on account of the increased expense. No license law work was done during the year by the national committee as no funds were available, and but few legislatures met. Caution in spending money for this purpose was advocated, the work preferably being left to states.

Continuation of the budget method of appropriations was favored.

President Damon urged strongly that the heartiest support be given to the Uniform Boiler Code Committee which has in charge furtherance of the adoption of the A. S. M. E. Rules, and that all engineers do all possible in local and state associations to have this code adopted in every state.

Decision was announced of the suit by the Lanward Publishing Co. against the Association giving some $6000

to the company with costs, altogether $7500, which has tied up this amount of funds pending an appeal, but it is a grave question whether the appeal will be successful. Arrangements were made with the American Surety Co. for bonding all officers of national and subordinate associations at a combination rate based on the amount of business done.

Some objection was voiced to the method of handling exhibit arrangements of the state conventions, and a greater control by the local committee advocated, but this may not be agreed to by all who have followed the management of exhibits over a number of years. Although biennial conventions are not yet favored by the local associations, greater power for state associations was urged, also more care in expenditures for national conventions and accumulations of an emergency fund by setting aside 5 per cent of the gross income until $10,000 has been provided, this sum to be held for special needs and any moneys taken from it to be replaced as soon as possible.

PRESIDENT JOHN A. KERLEY

Unsatisfactory gains in membership were reported and a net loss of six local associations, with recommendation of the appointment of a paid national organizer and appropriation of $3500 to carry on the work.

Selection of a central city for the 1917 convention was favored to reduce mileage expense, which is a large item each year.

Credentials report gave 313 delegates in attendance, and the secretary reported receipts for the year of $32,125.40, which was turned over to the treasurer. Treasurer's report showed $32,211.82 received during the year and $25,011.50 expended.

Report of Vice-president Kerley recommended working out of more modern business methods for all departments of the work by a committee of past presidents, and more vigorous cooperation of educational and license committees to secure economy and safety. During the year four locals have been reinstated, six have returned their charters, three have disbanded and ten have been dropped, while nine new locals have been organized, making a net loss of six.

Educational work prospered during the year, the committee reporting some 400 illustrated slide lectures being used and a new lecture with slides on Corliss Valve Gears being made available. Also several sets of slides on electric lighting were loaned by the Edison Lamp Works of Harrison, N. J., and a set on the Universal Unaflow Engine by the Skinner Engine Co. of Erie, Pa. Lectures on Refrigeration, Turbines, Boilers and Stokers are in course of preparation, also a lecture and slides on Pumps and Pumping Machinery.

Establishment of a Data Bureau was suggested for accumulating cost data in regard to operation of plants, so that members may have actual facts as to cost of producing steam and electric power in various types and sizes of plants for comparison and standardization, and that $300 be set aside for such work.

Expenditure of $2000 for educational work was recommended, the securing of lectures on Elevators, Indicator Cards, Slide Valves and Heating and Ventilating. Awarding of prizes for competitive papers was favored and a reprint of Questions and Answers.

Activity by states for license laws was urged by the license committee, and report made that Rhode Island, Washington, Wisconsin, Maryland, and Colorado are active in the matter.

Following the reports an address was delivered by Dr. C. A. Prosser, director of Dunwoody Industrial Institute, telling of the work done by the students in day and evening classes, numbering some 2500, and how classes are arranged to suit the convenience of those engaged in various trades. Teachers are drawn from the master craftsmen of the trades and every effort made to "open the door of advancement to merit."

In the evening a class of 50 candidates was initiated into local No. 8 of Minneapolis by the national officers, the rest of the evening being spent in examining the display in the exhibit hall.

Midweek

Again, and promptly at 9:30 delegates came to order on Wednesday morning to hear reports. Peace had reigned during the year so the Board of Arbitration had no cases, and no calls had been made on the protection funds. Systematic keeping of information on license laws was advocated by T. W. Roberts, to include all proposed bills and amendments as well as actual laws. He also gave some history of the passage and working of the Ohio law indicating that compromises are necessary and subsequent amendments to secure passage and remedy oversights.

J. D. Taylor, speaking of isolated plant vs. central station, gave instances showing the need of cost keeping to prove the case of the isolated plant when replacement by central power comes up for consideration. Examples were quoted of central station rates made and varied in attempting to secure business, the rate apparently being based on what was needed to secure a contract rather than on cost of production. Other delegates in discussion agreed as to the need of cost data and cost records to defend the plant against assertions made, and emphasized the simplicity of keeping records and the added interest in operating a plant from comparison and attempt to better results.

Professor J. J. Flather of the University of Minnesota then delivered a finished address on "The History and Development of Engineering," detailing and illus-

trating to how great an extent the necessities and comforts of civilization are due to the engineers' activity, and that these achievements and increased progress have been due largely to the advance in physical sciences, the discovery of scientific fact often preceding by years the applications in industrial arts. This progress was outlined in various fields from the early building of monuments, pyramids, roads and fortifications down to our own complex works and machinery, division into separate branches becoming more minute as complexity increased. Especially was mentioned the work of James Watt, who gave to the steam field the separate condenser, the throttling governor, the piston rod and stuffing box, the crank and shaft, steam jacketing for cylinders and the downdraft furnaces as a smoke consuming device.

Mileage and Flour Mills

Apparently unrelated, these topics were brought together in the meeting of Wednesday afternoon. Acting on the report of the mileage committee it was found that owing to the small attendance 5 cents a mile could be paid. Then followed a number of talks calling attention to the benefit of greater publicity for the Association and the need of work from within to build up local associations and avoid dry rot, also the advantage of persistent effort to build up economical operation of plants, operated by members, by cooperative action.

H. F. Mueller, chief engineer of Washburn-Crosby Flour Mills gave a history of flour milling and outlined the processes used for converting raw wheat into its various products. In this work some 60,000 hp. is used at Minneapolis from the Mississippi River, and this is supplemented by a large amount supplied by steam plants. The description was supplemented by a visit to the Washburn-Crosby Mills, where the methods described were seen in actual operation.

Life and Accident

Meeting of the Life and Accident Department showed an active year, sixty-seven claims having been allowed and fifty-four paid. Eight assessments were made during the year, which with annual dues made the cost $9 per member for carrying a policy of $500 death or disabling accident under four possibilities. Accumulation of a reserve fund was recommended to permit more prompt payment of claims, which are now delayed by collection and limitation on number of assessments permitted.

J. D. Taylor, secretary-treasurer, expressed the opinion that the cost has been too low for the risk carried. He endeavored to improve the situation by offering prizes for bringing in younger men, $5 for the greatest number under 30 yr., $3 for the largest number between 30 and 35, and $2 for the largest number from 36 to 40 yr. For the first prize, No. 28 of Chicago, Ill., and No. 7 of Bayonne, N. J., were tied; for the second, No. 2 of Los Angeles, Calif., and No. 1 of Jersey City, N. J., were tied; and for third No. 44 of New York, N. Y., No. 15 of Pittsburgh, Pa., and No. 14 of Boston, Mass., were tied. The prizes are to be divided.

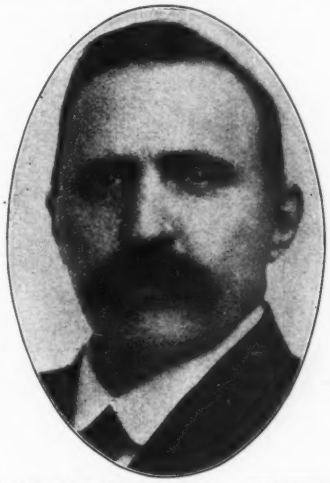
On election of officers, Judson Pratt of Cincinnati was elected a trustee and chairman of the board, and J. D. Taylor of New York City was re-elected secretary-treasurer. J. G. Beckerleg, who for many years has been chairman, was given a vote of thanks for long and untiring service.

Evening saw the delegates and many visitors busy in the exhibit hall until "lights out" was ordered, when all adjourned to a midnight burlesque.

The Day Before Last

Not yesterday, nor day before, but Thursday, for the convention closed on Friday. Anyway, everybody was on hand—promptly—at 9:30—Damon had them trained—and Editor Lane spoke, offering a resolution that at future conventions at least an hour each of Wednesday and Thursday meetings be devoted to discussion of power plant welfare topics, which was adopted.

C. W. Obert, secretary of the Uniform Code Committee on the A. S. M. E. Code urged the need and desirability of furthering the enactment of this code into law in all states, five having already taken that step.



VICE-PRESIDENT JOHN A. WICKERT

Trustees' report showed somewhat increased receipts from the association journal, though not equal to those of 1914. Satisfactory progress was reported in business management and editorial policy.

Reports of committees showed the accounts correct, referred to a referendum vote the reduction of the educational committee from five to three members, and the establishment of a permanent reserve fund of $10,000, and that $2000 be appropriated for propaganda work. The financial items were defeated by the convention, and the educational committee change approved. A budget for the year's work totaling $30,000 was adopted, the mileage being paid at 5 cents, more than had been anticipated.

Delegates from the Ladies' Auxiliary were then received and told of the work of the year for the pension fund, the increase of monthly allowance for disabled members from $15 a month to $17, collection of $103.70 for the fund at the convention. Memorial addresses were then delivered in remembrance of deceased members and a tribute of silence paid to their memory.

Various changes in constitution were submitted, clarifying the process of referendum vote, allowing representation to state associations at national conventions, making membership of locals in state associations where

such exist compulsory, apportioning 5 cents of per capita tax to the pension fund, prohibiting giving out names and addresses of members, and permitting formation of district associations. Most of these were passed on to the referendum committee, but the feature of district associations was defeated.

Early adjournment was taken as an outdoor frolic had been planned for the afternoon, but the weather man was unkind, and a cold raw wind drove most of the delegates to shelter and indoor sports.

Friday and Closing

Excitement in the closing session centered around the matters of authorizing district associations, which, after earnest discussion was disapproved, and election of vice-president in which John A. Wickert of Milwaukee was successful.

Greetings were received from the Canadian Association, and a return message sent by Secretary Raven. Presentation of altar flags was made to those associations which had earned them by increase in membership.

H. D. RAYMOND, PRESIDENT N. E. A.

It was ordered that in appointing the license law committee, the incoming president select national officers and that this committee compile all laws to date, city ordinances, court decisions and proposed bills, so that the information may be available for any member desiring it.

Election of officers was then taken up and resulted in choice of John A. Kerley of Cincinnati for president; John A. Wickert of Milwaukee for vice-president; Fred W. Raven of Chicago for secretary; Samuel B. Forse of Pittsburgh for treasurer; Joseph O'Connell of Chicago for trustee; George I. Vaughn of Salt Lake City for conductor; Charles Manker of Mobile for doorkeeper.

Passing to choice of convention city for 1917, Evansville, Ind., was selected by practically a unanimous vote. Resolutions of thanks to city officials, local committee, and exhibitors were adopted and recess was then taken until evening, when the officers were installed at Hotel West, preceding the grand ball which closed the convention. The call of Monday's whistle took many away on the early evening trains, and others who remained for the ball generally departed on the midnight expresses, carrying pleasant memories of the Flour City and its hospitalities of the week.

Exhibitors and Exhibits

As a rest after getting all exhibits in shape for Monday evening opening, the exhibitors held a meeting in the afternoon to receive reports of officers and transact routine business. No matters out of the ordinary came up, and the nominating committee posted Tuesday afternoon the regular ticket which was elected without opposition.

The new officers are: President, H. D. Raymond of A. W. Chesterton Co., Boston; vice-president, Paul T. Payne of Dearborn Chemical Co., Chicago; treasurer, H. A. Smith of Philadelphia Grease Co., Philadelphia; executive committee, Charles Cullen of Wm. Powell Co., Cincinnati; F. N. Chapman of A. Leschen & Sons Rope Co., St. Louis; T. C. Green of Garlock Packing Co., Palmyra, N. Y.; C. A. Wilhoft of New York Belting & Packing Co., New York; L. W. Brooks of Jos. Dixon Crucible Co., Jersey City, N. J.

At the final meeting of the Exhibitors' Association on Friday afternoon it was voted that the exhibit be closed

PAUL T. PAYNE, VICE-PRESIDENT N. E. A.

on adjournment of the business meetings of the N. A. S. E. Secretary J. W. Peterson reported that the funds in hand would pay all bills of the convention and leave a balance sufficient for the needs of the year.

In the exhibit hall, space was taken by 110 firms, occupying 160 booths. General satisfaction was expressed with the pleasing color scheme of green and white, the convenient arrangement of booths and wide aisles and the compliance of all exhibitors with the regulations.

The list of firms whose product was shown was as follows:

Albany Lubricating Co., New York, N. Y.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Engineering Co., Philadelphia, Pa.
American Steam Gauge and Valve Mfg. Co., Boston Mass.
American Steam Pump Co., Battle Creek, Mich.
Anchor Packing Co., Philadelphia, Pa.
Anderson Co., V. D., Cleveland, Ohio.
Andrews, Wm., Inc., New York, N. Y.
Arctic Ice Machine Co., Canton, Ohio.
Arrow Boiler Compound Co., St. Louis, Mo.
Ashton Valve Co., Boston, Mass.

Baker Valve Co., Minneapolis, Minn.
Bishop, Babcock, Becker Co., Cleveland, Ohio.
Belmont Packing Co., Philadelphia, Pa.
Bowers Rubber Works, San Francisco, Calif.
Bowser, S. F. & Co., Inc., Ft. Wayne, Ind.
Bros, Wm., Boiler Mfg. Co., Minneapolis, Minn.
Builders Iron Foundry, Providence, R. I.
Carey Co., Philip, Lockland, Ohio.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Chapman Ball Bearing Co., Cleveland, Ohio.
Chesterton Co., A. W., Boston, Mass.
Climax Western Oil Co., Minneapolis, Minn.
Cling-Surface Co., Buffalo, N. Y.
Clipper Belt Lacer Co., Grand Rapids, Mich.
Combustion Appliance Co., Chicago, Ill.
Colles Heater Co., Chicago, Ill.
Crandall Packing Co., Palmyra, N. Y.
Crane Co., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Dean Bros. Steam Pump Works, Indianapolis, Ind.
Dearborn Chemical Co., Chicago, Ill.
Detrick Co., M. H., Chicago, Ill.
Dick, R. and J., Ltd., Passaic, N. J.
Dixon Crucible Co., Jos., Jersey City, N. J.
Duncan Electric Mfg. Co., Lafayette, Ind.
Durable Mfg. Co., New York, N. Y.
Electric Machinery Co., Minneapolis, Minn.
Elliott Co., Pittsburgh, Pa.
Ellison, L. M., Chicago, Ill.
Erie City Iron Works, Erie, Pa.
Erie Pump & Equipment Co., Erie, Pa.
Federal Metallic Packing Co., Boston, Mass.
Fisher Governor Co., Marshalltown, Ia.
Ford Co., Thos. P., New York, N. Y.
France Packing Co., Tacony, Philadelphia, Pa.
Freeman & Sons Mfg. Co., S., Racine, Wis.
Garlock Packing Co., Palmyra, N. Y.
Greene, Tweed & Co., New York, N. Y.
Hanks-Price Co., Minneapolis, Minn.
Hawk-Eye Compound Co., Chicago, Ill.
Hyatt Roller Bearing Co., Harrison, N. J.
Hildred-Nelson Co., Minneapolis, Minn.
Hill Publishing Co., New York, N. Y.
Hills-McCanna Co., Chicago, Ill.
Hill-Tripp Pump Co., Anderson, Ind.
Home Rubber Co., Trenton, N. J.
Hoppes Mfg. Co., Springfield, Ohio.
Indian Refining Co., New York, N. Y.
International Correspondence Schools, Scranton, Pa.
Jenkins Bros., New York, N. Y.
Johns-Manville Co., H. W., New York, N. Y.
Johns-Pratt Co., Hartford, Conn.
Keasbey & Mattison Co., Ambler, Pa.
Keeler Co., E., Williamsport, Pa.
Keystone Lubricating Co., Philadelphia, Pa.
Keystone Pulley Co., Philadelphia, Pa.
Kunz Oil Co., Minneapolis, Minn.
Lagonda Mfg. Co., Springfield, Ohio.
Leschen & Sons Rope Co., A., St. Louis, Mo.
Liberty Mfg. Co., Pittsburgh, Pa.
Lunkenheimer Co., The, Cincinnati, Ohio.
Manning, Maxwell & Moore, Inc., New York, N. Y.
Mason Regulator Co., Boston, Mass.
McCord Mfg. Co., Detroit, Mich.
McCullough Mfg. Co., Minneapolis, Minn.
McLeod & Henry Co., Troy, N. Y.
Mining World Co., Chicago, Ill.
Mueller Boiler Compound Co., Minneapolis, Minn.
National Engineer, Chicago, Ill.
National Tube Co., Pittsburgh, Pa.
Nelson Blower and Furnace Co., Boston, Mass.
New York Belting & Packing Co., New York, N. Y.
New York Leather Belting Co., New York, N. Y.
Northwestern Electric Equipment Co., St. Paul, Minn.
Nott Co., W. S., St. Paul, Minn.
Ohio Blower Co., Cleveland, Ohio.
Ohio Elevator Co., New York, N. Y.
Peerless Rubber Mfg. Co., New York, N. Y.
Perolin Co. of America, Chicago, Ill.
Philadelphia Bourse, Philadelphia, Pa.
Philadelphia Grease Mfg. Co., Philadelphia, Pa.
Platt & Washburn Refining Co., New York, N. Y.
Pocock & Pollard, Minneapolis, Minn.
Powers Regulator Co., Chicago, Ill.
Powell Co., Wm., Cincinnati, Ohio.
Power Equipment Co., Minneapolis, Minn.
Practical Engineer, Chicago, Ill.
Precision Instrument Co., Detroit, Mich.
Quaker City Rubber Co., Philadelphia, Pa.
Reliance Gage Column Co., Cleveland, Ohio.
Richardson-Phenix Co., Milwaukee, Wis.
Richardson Scale Co., Passaic, N. J.
Robinson Cary & Sands Co., Minneapolis, Minn.
Roebling's Sons Co., John A., Trenton, N. J.
Roto Co., The, Hartford, Conn.
S. C. Regulator Co., Fostoria, Ohio.
S. K. F. Ball Bearing Co., New York, N. Y.
Schieren Co., Chas. A., New York, N. Y.
Simonds Co., G. L., Chicago, Ill.
Skinner Co., M. B., Chicago, Ill.
Smith Co., W. R. C., Atlanta, Ga.
Squires Co., C. E., Cleveland, Ohio.
Taylor Instrument Companies, Rochester, N. Y.
Texas Co., New York, N. Y.
Toledo Pipe Threading Mach. Co., Toledo, Ohio.
Travelers Indemnity Co., Hartford, Conn.
U. S. Graphite Co., Saginaw, Mich.
Universal Valve Co., Chicago, Ill.
Union Steam Pump Works, Battle Creek, Mich.
Vacuum Oil Co., Rochester, N. Y.
Vanda Co., The, New York, N. Y.
Vulcan Fuel Economy Co., Chicago, Ill.
Walworth Mfg. Co., Boston, Mass.
Warren Webster Co., Camden, N. J.
Western Valve Co., Chicago, Ill.
Westinghouse Traction Brake Co., Pittsburgh, Pa.
Whitacre Co., R. B., Minneapolis, Minn.
Williams Co., D. T., Cincinnati, Ohio.

EXPERIMENTS in France show that with a mixture of 1 part benzol and 1 part alcohol an automobile attained a speed of 42 mi. per hr. and gave 4.66 mi. per pint of fuel, as against 44 mi. per hr. and 3.6 mi. per pint with gasoline. Starting must, however, be done with gasoline, benzine or ether from a separate tank. The regular carburetor was used.

Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

Carrier Air Washer

CLEAN, humidified air for cooling generators and transformers is now considered an important factor in the operation of large plants for increasing efficiency and capacity and reducing upkeep costs. It was this need that led to the development of the Carrier air washer for this special purpose.

This apparatus consists of a chamber which is kept filled with a very finely atomized spray of water and through which the air is drawn by a fan, usually a part of the generator. The air is thereby cooled and all particles of dirt, dust and soot are saturated with water which increases their weight. At the exit end of the washer the air passes through vertical eliminator plates which separate all free moisture and dirt from the air, so that the air emerges cool, clean and free from entrained water, yet saturated to approximately 100 per cent humidity, and is then drawn into the generator.

Referring to Fig. 1, it will be noted that water entering the spray nozzle is given a centrifugal action which produces an atomizing effect as it emerges from the nozzle. The greatest atomizing effect is obtained at a pressure of 30 to 35 lb. As the water approaches the opening, an increase in velocity is caused by the change in the shape of the passage until it bursts into an atomized spray, which does not depend for its fineness on the small size of the orifice. For this reason comparatively larger water passages, ranging from 3/16 to ¼ in., are used throughout, with consequent freedom from clogging, all water having first passed through a No. 12 mesh brass screen.

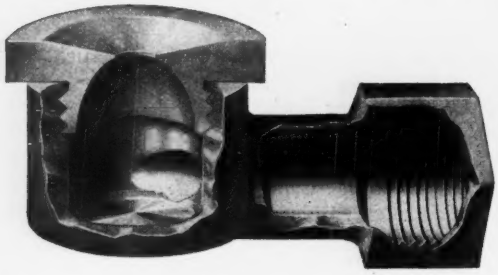


FIG. 1. SECTION OF CARRIER ATOMIZING NOZZLE

In passing through the eliminators at a high velocity, the particles of water are caught by the troughs formed by the projecting hips and the water drained to the tank below.

Over the top of the eliminators are provided a second set of flooding nozzles to keep their surfaces at all times thoroughly wet, washing the foreign matter from the air and down into the settling tank.

Extending under the entire apparatus, the settling tank contains a large volume of water which allows the particles of dirt and dust to settle to the bottom before the water is again drawn by the pump through the filtering screen to be used again. The pump is of the horizontally split shell centrifugal type with an enclosed runner and usually driven by direct connected motor through a flexible coupling.

This apparatus is the product of the Carrier Air Conditioning Co., of Buffalo, N. Y.

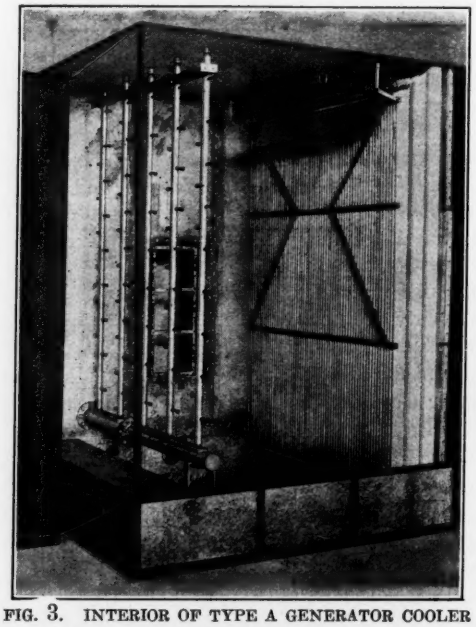


FIG. 3. INTERIOR OF TYPE A GENERATOR COOLER

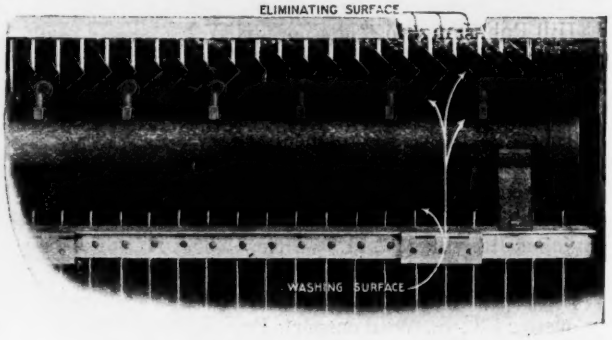
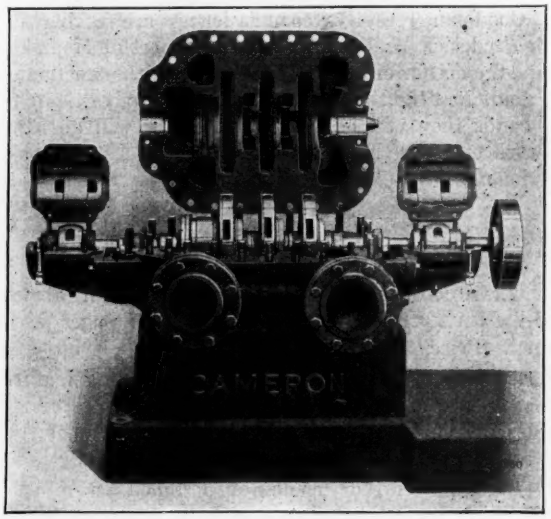


FIG. 2. FRONT VIEW OF ELIMINATORS

An Improved Centrifugal Pump

WHILE the developments of the steam turbine and the high-efficiency multi-stage centrifugal pump have gone hand in hand, it has not, up to the present, been entirely practicable to operate them together. It was necessary, heretofore, to reduce the speed of the turbine and sacrifice much of its efficiency or else speed up the pump with similar results. To overcome this difficulty, the Cameron Steam Pump Works, 11 Broadway, New York, has designed and built a multi-stage centrifugal pump known as the Type B-T.

The casing of this pump is divided along the horizontal centerline, the upper half being readily removable and giving full access to the revolving element. Both suction and discharge connections are in the lower half of the casing. There are suitable openings for draining the pump and for displacing the air when starting. Inlet and outlet nozzles can be arranged on either the same or opposite sides—an important advantage where pumps are installed in limited space.



INTERIOR CONSTRUCTION OF CAMERON TYPE B-T 3-STAGE CENTRIFUGAL PUMP

The shaft is made of high-grade forged steel accurately machined and ground, and wherever it comes in contact with the fluid being pumped, it is thoroughly protected by bronze sleeves, which prevent the stuffing-box packing from scoring the surface of the shaft.

Each impeller is cast solid in one piece and is of the enclosed type. Surrounding each impeller hub is a pair of rings—one stationary, attached to the casing, and one revolving, attached to the impeller. By the use of double rings instead of a single ring it is possible to restore the initial tightness of the joint between the low- and high-pressure sides of each stage without any fitting whatever, whereas a new single ring would have to be of special diameter, and then fitted to the impeller hub, or the casing to make a tight joint.

The diffusion ring surrounds the impeller at its periphery, although not in contact with it. It contains a series of openings, which receive the water from the impellers at high velocity and by means of a gradually increasing sectional area toward the periphery, reduce the velocity into pressure and enable it to advance to the entrance to the next impeller with much less loss of energy than would be the case if the high velocity of ejection were maintained.

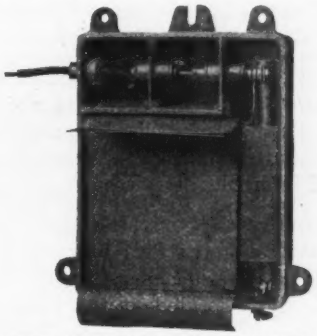
To take care of thrust this pump is equipped with a simple internal hydraulic balancing device consisting of a revolving disc attached to the shaft at the inboard or high-pressure end. Opposite this disc is a stationary drum of the same diameter. Water at high pressure connects with the space between the disc and the drum, causing the disc to re-act against the opposing thrust, neutralizing it and holding the rotor in proper relation to the casing. The slight leakage involved in this process is piped back to the suction.

Two ring-oiled bearings, self-alining, one located on each side of the casing, are employed. The bearing bodies are horizontally split, with removable caps, and the bushings are also split and lined with high-grade bearing metal. Bushings and bearing bodies have a spherical fit, automatically maintaining the alinement of the shaft. The bearings are of ample proportions to prevent heating and are supported by strongly ribbed brackets, cast integral with the lower casing, thus counteracting any possible tendency towards even slight vibration. These brackets are located sufficiently distant from the stuffing-boxes to permit adjustment of the glands. Felt washers are provided to prevent oil escaping from the bearings.

The stuffing-boxes are deep and provided with water seals, consisting of a lantern gland in each box, connected to the water from the discharge side of the pump, through a concealed passage, so arranged that it can be readily cleaned.

Condenser Type Direct-Current Lightning Arresters

THE arrester illustrated herewith, recently placed on the market by the Westinghouse Electric & Mfg. Co., is for use on voltages from 100 to 1500 direct current, and is especially adaptable for the protection of direct-current railway and power motors, direct-current



INTERIOR VIEW, WESTINGHOUSE CONDENSER TYPE DIRECT-CURRENT LIGHTNING ARRESTERS

generators, and rotary converters. This arrester is made in 2 forms, one consisting of a condenser with a spark gap in series with it and a high resistance in shunt with

it, for car and station service, the other consisting of the condenser alone, without series gap or shunt resistance, for line mounting. The condenser is of the flat plate form, of high electrostatic capacity and amply tested for breakdown voltage. For car mounting, the condenser is of 1 microfarad capacity, equivalent to the capacity of 100 miles of average line. For line mounting, the capacity of 0.3 microfarad, equivalent to the capacity of 30 miles of average line. In the line mounting form, without gap or resistance, the condenser is connected direct to the line and ground terminals. In the forms that include gap and resistance, the line terminal is connected through an adjustable spark gap in a separate chamber. This gap is in series with the condenser, the ground lead being connected to the case, and a resistance is connected in shunt across the condenser serving to keep it discharged to zero value. This resistance is so high that even with the spark gap closed only a negligible amount of direct current can flow. The spark gap provides a means of noting the discharge of the arrester by placing a test paper in the gap. It can be easily adjusted and set so close as just to prevent line voltage from bridging it.

News Notes

SARCO CO., INC., in view of the increase of business, has opened a new office at 963 Drexel Building, Philadelphia, Pa., under the management of F. C. Perkins.

THE AMERICAN SOCIETY of Refrigerating Engineers will hold its twelfth annual meeting at the Engineering Societies Building, 29 West 39th St., New York City, on Dec. 4, 5 and 6, 1916.

THE CHICAGO office of The Ashton Valve Co. was removed Sept. 1, to 608 S. Dearborn St., Transportation Building, where the business of the company in this territory will be transacted.

THE BOUND BROOK Oil-less Bearing Company is erecting a re-enforced concrete building 50 by 100 ft. at its Plant No. 2, to take care of the rapidly growing business in its Nigrum Impregnated Wood Bearing Department.

HOMESTEAD VALVE MANUFACTURING CO., Pittsburgh, Pa., has appointed the O. C. Keckley Co., of 608 S. Dearborn St., Chicago, Ill., as its Western representative, having full charge of the sales of Homestead Valves in parts of Illinois, Iowa and Wisconsin.

D. C. GREEN, manager of the Salt Lake division of the Utah Power and Light Co., has resigned, having accepted the position of general manager of the Fort Smith Light and Traction Co., operating the electric light, gas and interurban services.

THE SCHAEFFER & BUDENBERG MFG. CO., Brooklyn, N. Y., announces that its Secretary, C. E. Georgi has been appointed Western manager of the company, and is now permanently located at the Chicago office, 427 S. Dearborn St.

PROTEST has been sent by a committee of Dayton, O., engineers, N. A. S. E. No. 37, to the Board of City Commissioners against the appointment of Karl Deal as smoke inspector on the grounds that Mr. Deal failed to pass a civil service examination for the position some 3 weeks previous; that he has not lived in Dayton a year as required by the rules in the city charter; and that a Dayton engineer did pass the examination for the position. Attention is also called to the grading of answers to examinations by one member only of the Civil Service Commission, with no appeal from his decisions. The letter calls attention also to the employment of unlicensed engineers in charge of the water works pumping station and of the garbage plant. The protest is signed by Frank Engle, S. E. Whallon and T. S. Garrett, committee.

AN EXTENSIVE electrical project, being worked out by a Pipestone, Minn., electric light company, soon will provide virtually every village in Pipestone County with 24-hr. service. Already the villages of Holland, Tosky, Edgerton and Woodstock have held special elections and by almost unanimous votes have authorized the issuance of bonds to build complete lighting systems. The current will be supplied from the Pipestone plant.

ACCORDING to a telegram received by Commissioner Leo Goodman recently, commissioners are taking up with Frederick W. Ballard, lighting expert of Memphis, Tenn., the matter of advertising bonds for the erection of the municipal lighting plant. After legal advertising of the bonds they will be sold and the city will go right to work erecting the plant, according to Commissioner Goodman.

Books and Catalogs

DYNAMOMETERS, by Rev. Frederick John Jervis-Smith, M.A., F.R.S.; New York, 1915; 267 pages, illustrated. Price, $3.50.

Economy of operation is one of the leading features of excellence of machinery either prime movers or machines driven by them, and so accurate dynamometric tests of such machines are of real importance.

Dynamometers, or machines designed to measure work, may be divided into 3 classes: the gravity, the frictional (including absorption machines), and the transmissional forms. These, and some of the methods used for obtaining numerical results, are considered in order. Water brakes, air brakes, magnetic brakes, and end thrust brakes, in their various forms, are briefly discussed. Friction and friction brakes are two subjects to which considerable attention is devoted. A collection of the results of dynamometric measurements carried out at the Millard Engineering Laboratory at Oxford (1886 to 1903) should be of interest to engineers, for the results will enable the reader to compare the different methods which have been used in estimating the output and efficiency of prime movers.

Much of the work in this book is of historical interest, for in the discussion of almost every subject, the early methods and applications are described, and then the development is carefully followed through to the modern forms. Early methods for estimating the force of a steam engine; how the unit of horsepower was derived, and how the use of a foot pound of work was first applied, are all explained in a commendable manner.

By reason of his deep study into the properties of metals as affected by mechanical stresses or heat, and a thorough knowledge of the principles of work-measuring machines and integrators, the author is well qualified to discuss the subjects which bear directly upon the science of dynamometry.

MECHANICAL ENGINEERS' HANDBOOK, edited by L. S. Marks, 4½ by 7 in., 1800 pages with full illustrations, leather binding, price $5.00, New York, 1916.

This handbook is intended to supply the practicing engineer with a reference work covering the field of mechanical engineering comprehensively. It has been based on the method of the 3-volume German work by Hutte, utilizing the knowledge of a group of specialists, each one preparing the section on his own subject.

The first 860 pages are devoted to the more theoretical topics, such as Mathematics, Mechanics, Materials of Engineering and Elements of Machinery. The last part includes statement and discussion of current practice, including Power Generation, Hoisting and Conveying, Transportation, Buildings, Pumps and Compressors, and Refrigeration.

In the section on Mathematics, a very complete treatment of the graphical representation of equations is given, showing how to make up curves by the use of cross-section paper, and how to construct line charts for solving formulas.

In the section on Heat is given much information which has heretofore been available only in the German language. An interesting feature of the section on Transportation is the part devoted to aeronautics, which includes all the more important constants necessary for design.

In the section on Pumps and Compressors, much new data is given, particularly on centrifugal machinery of both pump and compressor type. A section on Electrical Engineering gives the main facts in regard to electrical principles, generators, motors and power distribution.

The book is very convenient for reference, as there are thumb index marks for quick turning to any section, complete table of contents, a full alphabetical index, and a brief topical index giving reference to the sections where different subjects are discussed. The main subjects are also indicated clearly by bold face type headings.

The only criticism of the book which might be made is that, in the effort to cover the field, it has been necessary to reduce the space allotted to each subject to the point where the treatment is, in some cases, meager. In a handbook, this is perhaps to be regarded as an advantage rather than a fault, since it is intended not for a textbook but to give quick information for daily use. The treatment of each subject by a recognized expert and authority is a method to be highly commended.

THE BUREAU OF STANDARDS, Department of Commerce, has just published a report which gives an account of the experimental work on which are based the expansion tables of Circular No. 57, "United States Standard Tables for Petroleum oils." It gives a detailed description of the methods and apparatus employed in the determination of the density and thermal expansion of petroleum oils from the various fields in the United States. This paper will be of interest to oil producers and refiners throughout the country. Copies of this report, Technical Paper No. 77, may be obtained without charge upon application to the Bureau of Standards, Washington, D. C.

A DELIGHTFUL BOOKLET, sent out by the Link-Belt Co., is entitled "Personal Reminiscences of James Mapes Dodge," written by Charles Piez. It is the story of a life of achievement and helpfulness, showing the development of the conveying and coal storage systems invented by Mr. Dodge, and of his interest in other departments of manufacture and shop practice. It also gives a charming impression of the strong, friendly man, who was so great a help to all who came in contact with him.

SMOOTH-ON Instruction Book No. 16, recently issued by Smooth-On Manufacturing Co., Jersey City, N. J., contains many new examples and illustrations showing the working of the different Smooth-On iron cements. The company will be pleased to send a copy to anyone sending name and address.

FROM STOW MANUFACTURING CO., Binghamton, N. Y., come bulletins as follows: No. 100, containing 20 pages, illustrating and describing electric motors; No. 101, containing 28 pages on Stow portable electric tools; 102, of 60 pages, illustrating the Stow flexible shaft with its many applications.

SPRACO SYSTEM for cooling condensing water is the subject of a new booklet, Bulletin No. 201, which illustrates the system as employed by various companies. The manufacturer is Spray Engineering Co., of Boston, Mass.

STEAM TRAP Catechism, a folder containing information on steam traps and diagrams of American Ideal steam traps, was lately issued by American Steam Gauge & Valve Mfg. Co., of Boston, Mass.

THE FRANKLIN flue gas analyzer for CO_2, O and CO is discussed in a new circular from G. Frank Duemler, 837 Sanger St., Philadelphia.

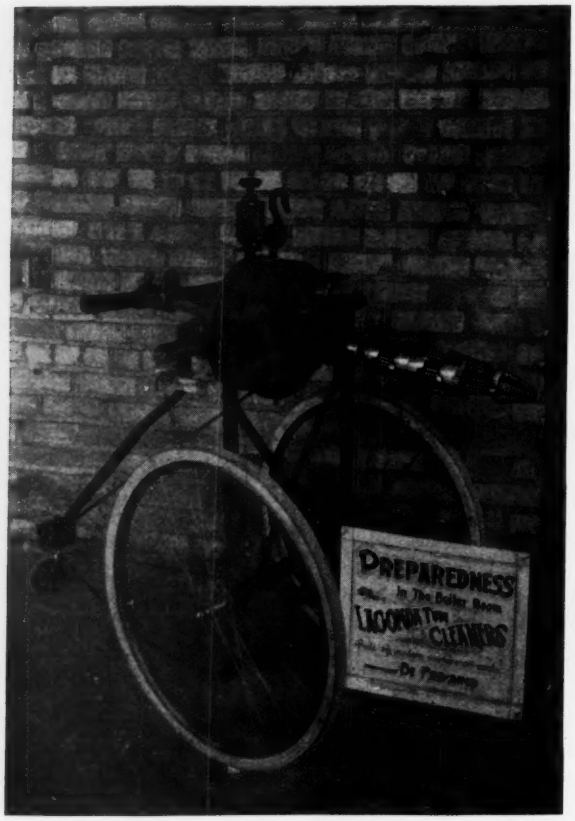
Trade Notes

MEETING OF THE sales managers and executives of the Combustion Enginering Corporation, 11 Broadway, New York, was recently held in that city at the invitation of George E. Learnard, vice-president. The time was spent in interchange of ideas and familiarizing the men with the recent improvements on the stokers and grates made by the corporation.

THE PACKARD ELECTRIC CO., Warren, O., has let contracts for the enlarging of its plant to double its present capacity. The work on the new addition will commence as soon as possible and is to be completed by Feb. 1. The contract price for the new building is $65,000. The addition to the present plant will be 140 by 64 ft., 3 stories and basement, and built of brick.

THE THOMAS P. FORD CO. of New York, manufacturing steam and water specialties, announces the appointment of E. H. Bolton and H. A. Hurckes as distributors of its Ford steam and water valve specialties for the middle west. Mr. Bolton has for some years been connected as sales engineer with the Colles Heater & Specialty Co., Chicago, and Mr. Hurckes comes from the field of practical engineering, having acted as chief engineer for the Illinois Vinegar Mfg. Co., Chicago, for the past 10 yr. The Chicago office will be at 1535 Lytton Building.

AT THE Minneapolis Convention exhibit, a feature that attracted special attention was the "preparedness" model of rapid fire tube cleaner shown at the Lagonda Mfg. Co.'s booth and illustrated herewith. While it



was designed as an attractive and convenient method of demonstrating the action of the cleaner, the carriage of this form is a mighty good suggestion for storing the cleaner and transferring it about the boiler plant as needed.

R. J. PARVIN, JR., has become associated with the Desmond Injector Co., Urbana, O., in the capacity of vice-president and manager of sales, having severed his connection with the Penberthy Injector Co., with whom he was connected for more than 5 yr. as western sales manager.

NEW YORK SCHOOL of Heating and Ventilating is sending out its prospectus for the 1916-1917 season. The first meeting for registration will be held Oct. 9, 1916.

PRACTICAL ENGINEER

Trade-mark, Reg. U. S. Pat. Off.

PUBLISHED ON THE FIRST AND FIFTEENTH OF EACH MONTH.

SEMI-MONTHLY

Subscription price in advance in the United States, Mexico or united possessions, $1.00 a year.
In Canada, subscription price, $1.75 a year.
Foreign Countries, subscription price, $2.50 a year.

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Any advertiser is invited to examine our paid subscription lists and Post Office mailing receipts at any time.

ADVERTISING RATES

Display

Full page, one year, each insertion, $60.00.
Half page, one year, each insertion, $35.00.
Quarter page, one year, each insertion, $20.00.
Eighth page, one year, each insertion, $12.00.
Front cover $150.00 per issue.
Other specified positions, regular rate plus 10 to 50 per cent.
Stippled plates used, but no heavy, black and white plates.

Classified Rates

Per line, 30 cents each insertion.
Advertisements in this section are inserted under regular headings.
No display type allowed, but the first three words may be set in capital letters.
About nine words make a line. Minimum space sold, two lines.
Under classification "Position Wanted," advertisements not exceeding four lines will be inserted once for subscribers free of charge.
All copy should be received at Chicago office 18 days before date of publication.

Circulation of this issue, 22,500.

Technical Publishing Co.
537 S. Dearborn Street
Chicago

Position Wanted

POSITION WANTED—Young, sober and reliable married man, as engineer. Six years' experience with a.c. and d.c. compression ice plants, Corliss, high speed and slide valve engines. Ambitious. Desire change where advancement is possible. Open October 1st. R. Bruce, Caruthersville, Mo. 8-15-1

POSITION WANTED—Young man, age 28, as engineer in New York or Brooklyn. Hold marine, stationary and refrigeration license. Day work, 8-10 hours, desires to go to school nights. Write for particulars. Box 452, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. 10-1-2

POSITION WANTED—Young man wishes position as oiler or assistant engineer in a plant in New York City. Two years' practical experience. Write William Brand, 24 Locust Hill Ave., Yonkers, N .Y. 10-1-

POSITION WANTED—As master mechanic, superintendent, chief engineer or erecting engineer. Have practical and technical experience in designing, erecting and operating central stations, power transmission and distributing systems, refrigerating and ice making plants and saw mills. For years connected with the largest machinery importing and engineering house in the Orient as estimator, selling and erecting engineer. Have traveled extensively, both in the Orient and Latin Americas. Know the Spanish and Italian languages. Have executive ability and can produce results. Will accept position to go anywhere for party offering proper inducements. Box 451, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. 10-1-1

STEAMFITTER—Accustomed to high pressure work, wants permanent situation. American and strictly sober always; am not afraid of plenty of work. Can work from blue prints, as well as do all kinds of general repairs. Have some experience in millwright work and some knowledge of steam engineering. H. L. Simonds, Box 166, Sac City, Iowa.

Help Wanted

WANTED—Resident subscription agents in the following cities: Atlanta, Ga.; Cincinnati and Columbus, Ohio; Kansas City, Mo.; Los Angeles, Cal.; Louisville, Ky.; Newark, N. J.; New Orleans, La.; Portland, Ore.; St. Louis, Mo.; San Francisco, Cal.; Washington, D. C. This is an excellent chance for a hustler who is familiar with power plant conditions, to turn his spare time into dollars. To such a one we offer a Real Opportunity. Write Subscription Department, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. tf.

WANTED—Young man for assistant engineer in medium sized packing house, to keep records, drafting, tests, etc.; some knowledge of theory desirable. Good opportunity for I. C. S. student. Address Box 445, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. 9-1-4

Wanted

WANTED—One 100 to 125-kv.a., 60-cycle, 3-phase, 220-volt generator with machine panel. Must be in good operating condition and guaranteed against mechanical and electrical defects. Quote best price, giving full information, size pulley, speed, make, etc. Address The French Oil Mill Machinery Co., Piqua, Ohio.

AGENTS WANTED for a power plant specialty. Territory east of Philadelphia not available. Merit of apparatus assured beyond a doubt. Our proposition to agents exceedingly attractive. Flynn & Emrich Co., Baltimore, Md. 9-1-4

WANTED—Agents handling engine and boiler room specialties to add side line paying big commissions. No samples to carry. Give experience, lines handled and territory covered. Address John L. Kneisly, 59 Green Street. Dayton, Ohio. 9-1-3

WANTED—Agents handling engine and boiler room specialties in every section for side line paying large commissions. Give experience, line carried and territory covered. Box 381, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. tf.

WANTED—Well versed boiler and combustion salesmen or established engineering agents to sell complete line of mechanical stokers, natural and forced draft; also steam jet ash handling system, on liberal commission lines. Box 453. Practical Engineer, 537 S. Dearborn St., Chicago, Ill. 10-1-4

WANTED—Agents on commission to sell our shaking grates. We will install grates on trial or put it on test at our expense with any grate made. Address Armstrong Mfg. Co., Springfield, Ohio. tf.

For Sale

FOR SALE—14x36 E. P. Allis Corliss engine, 100 hp., 100 r.p.m., cylinder re-bored, thoroughly overhauled one year ago; was good as new. Dubuque Brewing & Malting Co., Dubuque, Ia. tf.

FOR SALE—75-hp. Westinghouse, 2-cylinder steam engine in first-class shape; weight about 8000 lbs. Send for particulars. J. L. Lucas & Son, Bridgeport, Conn. 9-15-3

FOR SALE—Boilers—Six 262-hp. Babcock-Wilcox, 150 lb., Hartford certificate, $1000 each; four 150-hp. return tubular, 125 lb., Hartford certificate, $550 each. D. C. Units—100 kw. C. & C. with Erie engine, $1000; 75-kw. G. E. with Ames engine, $900; 50-kw. G. E. with Ames engine, $850. Send for latest stock of generators and motors, etc. A. C. Generators—125-kv.a. G. E., 60 cycle, 600 volt, $550; 100 kv.a. Allis-Chalmers, 60 cycle, 440-220 volt, $550; 75-kv.a. Fairbanks, 60 cycle, 440-220 volt, $450; 60-kv.a. Westinghouse generator, direct connected, Harrisburg engine, $1300. Power Machinery Exchange, Inc., 14 Morris St., Jersey City, N. J.

FOR SALE—Sand and gravel plant fully equipped for economic production. Centrally located, on Missouri River and two railroad systems. Good town and good shipping territory. Inexhaustible supply of sand and gravel. Has made money for years, and good management should double business first year. Plant is in fine condition. New buildings. Can be bought for less than invoice. Attractive terms to responsible man. For particulars address W. W. G. Helm, Boonville, Mo. 10-1-1

SECOND HAND GAS ENGINES FOR SALE—One 25-hp. Fairbanks gas engine, horizontal single cylinder; one 35-hp. New Era gas engine, horizontal single cylinder; one 40-hp. Reeves gas engine, 2 cylinder vertical. These engines are in good operating condition; disposing of equipment, due to installing new power plant with increased capacity. Address The French Oil Mill Machinery Co., Piqua, Ohio. 10-1-1

FOR SALE—18x42 Allis belted engine in thoroughly good condition. Double eccentrics. Steel lagging. Box 454, Practical Engineer, 537 S. Dearborn St., Chicago, Ill. 10-1-2

FOR SALE—90-hp. horizontal tubular boiler, good for 100 lb. pressure. Used very little. Priced to sell. Seevers Mfg. Co., Oskaloosa, Ia. 10-1-1

Patents and Patent Attorneys

PATENTS THAT PROTECT AND PAY—Advice and books free. High references. Best results. Promptness assured. Send sketch or model for search. WATSON E. COLEMAN, Patent Lawyer, 624 F St., N. W., Washington, D. C. t.f

PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. Washington, D. C. tf.

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 606 F St., Washington, D. C. Established 1883. I make a free examination and report if a patent can be had, and the exact costs. Send for full information. tf.

A. P. CONNOR, Consulting Electrical and Mechanical Engineer, Attorney-at-Law and Solicitor of Patents and Trade-Marks. Results guaranteed. 121 Carroll St., S. E., Washington, D. C. tf.-x.

PATENTS—Send sketch for free search and reports. Books and patents and book of reference letters sent free. John S. Duffie & Co., 612 F St., Washington, D. C. tf.

PATENTABLE IDEAS WANTED—Send for three free books. R. B. Owen, 28 Owen Bldg., Washington, D. C. tf.

Technical Books

QUESTIONS AND ANSWERS—Introductory set questions and answers on boilers sent on receipt of ten cents. Authentic and strictly educational. Richmond Engineering Bureau, Box 353, Haverhill, Mass. 9-1-1

Miscellaneous

FREE ENGINEER BOOKS and power plant tools and specialties, for securing new subscribers to Practical Engineer. A dandy chance for the engineer with a little spare time, to get some fine premiums. Send for free descriptive circular and terms. Subscription Department, Practical Engineer, 537 S. Dearborn St., Chicago, Ill.

ENGINEERS, DO YOU WANT to utilize your exhaust steam for heating or drying purposes without back pressure on your engine? If so, address Monash Engineering Co., 1413 W. Jackson Blvd., Chicago, Ill. tf.

Sparks From The Advertising Pages

That advertising is purging the system of business and the improvement of business ethics is affecting every line of industry, is shown by the Declaration of Principles adopted a few months ago by the Association of National Advertisers.

The resolutions are as follows:

RESOLVED, That we, members of the ASSOCIATION OF NATIONAL ADVERTISERS are opposed to advertising of the following kinds:

All advertising that is fraudulent or questionable, whether financial, medical or any other; all advertising that is indecent, vulgar or suggestive either in theme or treatment; that is "blind" or ambiguous in wording and calculated to mislead; that makes false, unwarranted or exaggerated claims; that makes uncalled-for reflections on competitors or competitive goods; that makes misleading free offers; all advertising to laymen of products containing habit-forming or dangerous drugs; all advertising that makes remedial, relief or curative claims, either directly or by inference, that are not justified by the facts or common experience; and any other advertising that may cause money loss to the reader or injury in health or morals or loss of confidence in reputable advertising and honorable business.

RESOLVED, That we recognize our own obligation as advertisers to conform to these principles.

RESOLVED, That we urge upon all publishers and upon all sellers of advertising space or service, a strict adherence to these principles, and that in so far as the exigencies of our individual business will permit, we direct our advertising to those mediums which make the observance of these principles their rule and practice.

Note particularly the lines underscored. In the second resolution we see that "false unwarranted or exaggerated claims" are opposed and in this connection we would call your attention to the advertisements in Practical Engineer. Look them over carefully. You will notice at once the lack of bombastic, boastful statements. Every claim is conservative and can be fulfilled to the letter. It is only this class of advertising that is permitted in the advertising section of Practical Engineer.

The last resolution we call your attention to as embodying principles the observance of which have long been the "rule and practice" of Practical Engineer.

Undoubtedly the members of this association, which represents the leading advertisers of America, were anxious to assure the proper companionship for their announcements on the grounds that an advertisement, like a man, is known and judged by the company it keeps.

These resolutions, added to the preponderance of evidence already recognized by many, prove still further the absolute uncertainty of buying unadvertised products. The manufacturer who is alive to this, advertises to maintain good will and the buyer who realizes it, buys advertised goods to obtain satisfaction.